73 Amateur Radio Today

SEPTEMBER 1998
ISSUE #456
USA $3.95
CANADA $4.95

International Edition

Rebecca Rich KB0VVT

The Incredible Lazy Loop

Build A Crystal Radio

Dogleg 10–40m Wire Vertical

Review:
Repeater Controller Kit

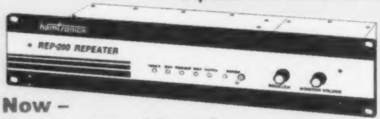
******************************5-DIGIT 48103
#00000191940WR5# JUN76 233
SERIALS PROCESSING DEPT 45
UNIV MICROFILMS IT P 1
300 N ZEEB RD
ANN ARBOR MI 48103-1553

0 74851 08725 1

Get more features for your dollar with our

REP-200 REPEATER

A microprocessor-controlled repeater with full autopatch and many versatile dtmf remote control features at less than you might pay for a bare bones repeater or controller alone!



Now –
2 meter machines in stock for next day shipment!

- ***kit still only $1095***
- ***factory assembled still only $1295***

50-54, 143-174, 213-233, 420-475 MHz. (902-928 MHz slightly higher.)
☞ FCC type accepted for commercial service in 150 & 450 MHz bands.

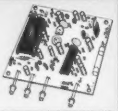
Digital Voice Recorder Option. Allows message up to 20 sec. to be remotely recorded off the air. Play back at user request by DTMF command, or as a periodical voice id, or both. **Great for making club announcements!** ....only $100.

REP-200C Economy Repeater. Real-voice ID, no dtmf or autopatch. .... Kit only $795, w&t $1195.

REP-200N Repeater. Without controller so you can use your own. .... Kit only $695, w&t $995.

You'll KICK Yourself If You Build a Repeater

Without Checking Out Our Catalog First!



Hamtronics has the world's most complete line of modules for making repeaters. In addition to exciters, pa's, and receivers, we offer the following controllers.

COR-3. Inexpensive, flexible COR module with timers, courtesy beep, audio mixer. .... **only $49/kit, $79 w/t.**

CWID. Traditional diode matrix ID'er. .... **kit only $59.**

CWID-2. Eprom-controlled ID'er. ..... **only $54/kit, $79 w/t.**

DVR-1. Record your own voice up to 20 sec. For voice id or playing club announcements. ....**$59/kit, $99 w/t.**

COR-4. Complete COR and CWID all on one board. ID in eprom. Low power CMOS. .... **only $99/kit, $149 w/t.**

COR-6. COR with real-voice id. Low power CMOS, non-volatile memory. ....**kit only $99, w/t only $149.**

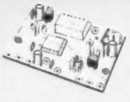
COR-5. µP controller with autopatch, reverse ap, phone remote control, lots of DTMF control functions, all on one board, as used in REP-200 Repeater. ....**$379 w/t.**

AP-3. Repeater autopatch, reverse autopatch, phone line remote control. Use with TD-2. ....**kit $89.**

TD-2. Four-digit DTMF decoder/controller. Five latching on-off functions, toll call restrictor. ....**kit $79.**

TD-4. DTMF controller as above except one on-off function and no toll call restrictor. Can also use for selective calling; mute speaker until someone pages you. ....**kit $49.**

SUBAUDIBLE TONE ENCODER/DECODER



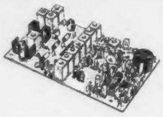
Access all your favorite closed repeaters!

- **Encodes** all standard CTCSS tones with crystal accuracy and convenient DIP switch selection.
- Comprehensive manual also shows how you can set up a front panel switch to select tones for several repeaters.
- **Decoder** can be used to mute receive audio and is optimized for installation in repeaters to provide closed access. High pass filter gets rid of annoying buzz in receiver. **New low prices!**

- **TD-5** CTCSS Encoder/Decoder Kit ....now only **$29**
- **TD-5** CTCSS Encoder/Decoder Wired/tested **$49**

CRYSTAL CONTROLLED VHF & UHF FM EXCITERS & RECEIVERS

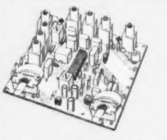
FM EXCITERS: 2W output, continuous duty.



- **TA51:** for 6M, 2M, 220 MHz ....kit $99, w/t $169.
- **TA451:** for 420-475 MHz. ....kit $99, w/t $169.
- **TA901:** for 902-928 MHz, (0.5W out) ....w/t $169.

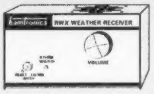
VHF & UHF POWER AMPLIFIERS.
Output levels from 10W to 100W .... **Starting at $99.**

FM RECEIVERS:



- **R100 VHF FM RCVR. Very sensitive** – 0.15µV. **Superb selectivity,** >100 dB down at ±12 kHz, best available anywhere, flutter-proof squelch. For 46-54, 72-76, 140-175, or 216-225 MHz. .... kit $129, w/t $189.
- **R144 RCVR.** Like R100, for 2M, with helical resonator in front end.................. kit $159, w/t $219.
- **R451 FM RCVR,** for 420-475 MHz. Similar to R100 above. .... kit $129, w/t $189.
- **R901 FM RCVR,** 902-928MHz ....$159, w/t $219.

WEATHER ALERT RECEIVER



A sensitive and selective professional grade receiver to monitor critical NOAA weather broadcasts. Good reception even at distances of 70 miles or more with suitable antenna. No comparison with ordinary consumer radios!

Automatic mode provides storm watch, alerting you by unmuting receiver and providing an output to trip remote equipment when an alert tone is broadcast. Crystal controlled for accuracy; **all 7 channels** (162.40 to 162.55).

Buy just the receiver pcb module in kit form or buy the kit with an attractive metal cabinet, AC power adapter, and built-in speaker. Also available factory wired and tested.

RWX Rcvr kit, PCB only	$79
RWX Rcvr kit with cabinet, speaker, & AC adapter	$99
RWX Rcvr wired/tested in cabinet with speaker & adapter	$139

WEATHER FAX RECEIVER

hamtronics
R139 WEATHER FAX RECEIVER

Join the fun. Get striking images directly from the weather satellites!

A very sensitive wideband fm receiver **optimized for NOAA** APT & Russian Meteor **weather fax** on the 137MHz band.

Designed from the start for optimum satellite reception; not just an off-the-shelf scanner with a shorted-out IF filter!

Covers all 5 satellite channels. Scanner circuit & recorder control allow you to automatically capture signals as satellites pass overhead, even while away from home.

R139 Receiver Kit less case	$159
R139 Receiver Kit with case and AC power adapter	$189
R139 Receiver w/t in case with AC power adapter	$239
Internal PC Demodulator Board & Imaging Software	$289
Turnstile Antenna	$119
Weather Satellite Handbook	$20

WWV RECEIVER

hamtronics
RWWV TIME RECEIVER

Get time & frequency checks without buying multiband hf rcvr. Hear solar activity reports affecting radio propagation. **Very sensitive and selective** crystal controlled superhet, dedicated to listening to WWV on 10 MHz. Performance rivals the most expensive receivers.

RWWV Rcvr kit, PCB only	$59
RWWV Rcvr kit with cabt, spkr, & 12Vdc adapter	$89
RWWV Rcvr w/t in cabt with spkr & adapter	$129

SYNTHESIZED VHF FM EXCITER & RECEIVER MODULES

No more waiting for crystals!

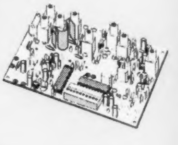
NEW

Hamtronics is pleased to announce a new line of its vhf fm transmitters and receivers, popular for repeaters, voice & data links, control, telemetry, and other demanding applications.

T301 Exciter and R301 Receiver provide high quality nbfm and fsk operation on 144-148 MHz and 220-225 MHz (also 139-174 MHz and 216-226 MHz for export and gov't services). Features include:

- *Dip switch frequency selection.*
- *Exceptional modulation for voice and ctcss.*
- *Very low noise synthesizer for repeater service.*
- *Direct fm for data up to 9600 baud.*
- *Commercial grade tcxo for tight frequency accuracy in wide range of environmental conditions.*
- *In stock for same day shipping.*

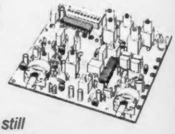
T301 EXCITER



Rated for continuous duty, 2-3W output.

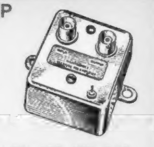
- **Kit** (ham band only) ...$109
- TCXO option ...$40
- **Wired/tested** ...$189 (includes TCXO)

R301 RECEIVER



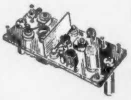
- **Kit** (ham band only) ...only $139
- TCXO option ...$40
- **Wired/tested** ...$209 (includes TCXO)
- Traditional crystal-controlled receivers & *exciters are still available for all vhf and uhf bands.*

LOW NOISE RECEIVER PREAMPS



LNG-( ) GaAs FET PREAMP
STILL ONLY $59, wired/tested

- Make your friends sick with envy! Work stations they don't even know are there.
- Install one at the antenna and overcome coax losses.
- *Available for 28-30, 46-56, 137-152, 152-172, 210-230, 400-470, and 800-960 MHz bands.*



LNW-( ) ECONOMY PREAMP
NOW ONLY $24/kit, $44/w&t

- Miniature MOSFET Preamp
- Solder terminals allow easy connection inside radios.
- *Available for 25-35, 35-55, 55-90, 90-120, 120-150, 150-200, 200-270, and 400-500 MHz bands.*

TRANSMITTING & RECEIVING CONVERTERS

hamtronics
RECEIVING CONVERTER

No need to spend thousands on new transceivers for each band!

- Convert vhf and uhf signals to & from 10M.
- Even if you don't have a 10M rig, you can pick up very good used xmtrs & rcvrs for next to nothing.
- Receiving converters (shown above) available for various segments of 6M, 2M, 220, and 432 MHz.
- Rcvg Conv Kits from $49, wired/tested units only $99.

- Transmitting converters for 2M, 432 MHz.
- Kits only $89 vhf or $99 uhf.
- Power amplifiers up to 50W output.

Buy at low, factory-direct net prices and save!
For complete info, call or write for complete catalog.
Order by mail, fax, email, or phone (9-12, 1-5 eastern time).
Min. $6 S&H charge for 1st lb. plus add'l weight & insurance.
Use Visa, MC, Discover, check, or UPS C.O.D.

See SPECIAL OFFERS and view complete catalog on our web site:
www.hamtronics.com
email: jv@hamtronics.com

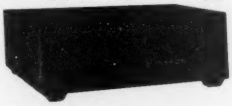
Our 36th Year
hamtronics, inc.
65-D Moul Rd; Hilton NY 14468-9535
Phone 716-392-9430 (fax -9420)

ASTRON CORPORATION

9 Autry
Irvine, CA 92618
(949) 458-7277 • Fax (949) 458-0826 www.astroncorp.com

SWITCHING POWER SUPPLIES

	CONT.	ICS	WT.(LBS)
SS-10	7	10	3.2
SS-12	10	12	3.4
SS-18	15	18	3.6
SS-25	20	25	4.2
SS-30	25	30	5.0



SS-25M With volt & amp meters
SS-30M With volt & amp meters

ASTRON POWER SUPPLIES

• HEAVY DUTY • HIGH QUALITY • RUGGED • RELIABLE •

SPECIAL FEATURES

- SOLID STATE ELECTRONICALLY REGULATED
- FOLD-BACK CURRENT LIMITING Protects Power Supply from excessive current & continuous shorted output
- CROWBAR OVER VOLTAGE PROTECTION on all Models except RS-3A, RS-4A, RS-5A, RS-4L, RS-5L
- MAINTAIN REGULATION & LOW RIPPLE at low line input Voltage
- HEAVY DUTY HEAT SINK • CHASSIS MOUNT FUSE
- THREE CONDUCTOR POWER CORD except for RS-3A
- ONE YEAR WARRANTY • MADE IN U.S.A.

PERFORMANCE SPECIFICATIONS

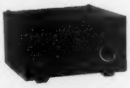
- INPUT VOLTAGE: 105-125 VAC
- OUTPUT VOLTAGE: 13.8 VDC ± 0.05 volts (Internally Adjustable: 11-15 VDC)
- RIPPLE Less than 5mv peak to peak (full load & low line)
- All units available in 220 VAC input voltage (except for SL-11A)

SL SERIES

- LOW PROFILE POWER SUPPLY

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
SL-11A	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

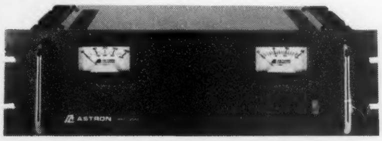
RS-L SERIES



- POWER SUPPLIES WITH BUILT IN CIGARETTE LIGHTER RECEPTACLE

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

RM SERIES



MODEL RM-35M

- 19" RACK MOUNT POWER SUPPLIES

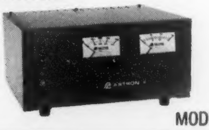
MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

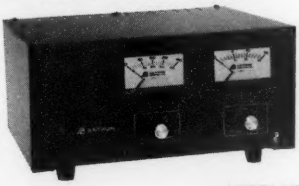
RS-M SERIES



MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

VS-M AND VRM-M SERIES



MODEL VS-35M

- Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	Continuous Duty (Amps) @10VDC	Continuous Duty (Amps) @5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
VS-70M	67	34	16	70	6 x 13¾ x 12⅛	48
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

- Built in speaker

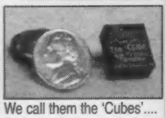
MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

RAMSEY

World's Smallest TV Transmitters

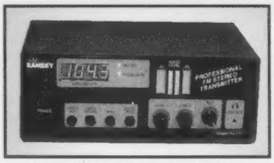


We call them the 'Cubes'.... Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies- that's a nickel in the picture!

Transmits color or B&W with fantastic quality - almost like a direct wired connection to any TV tuned to cable channel 59. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Basic 20 mW model transmits up to 300' while the high power 100 mW unit goes up to 1/4 mile. Audio units include sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Any of our cameras have been tested to mate perfectly with our Cubes and work great. Fully assembled - just hook-up power and you're on the air!

C-2000, Basic Video Transmitter Cube	**$89.95**
C-3000, Basic Video and Audio Transmitter Cube	**$149.95**
C-2001, High Power Video Transmitter Cube	**$179.95**
C-3001, High Power Video and Audio Transmitter Cube	**$229.95**

Super Pro FM Stereo Radio Transmitter

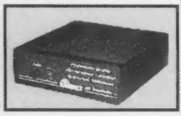


A truly professional frequency synthesized FM Stereo transmitter station in one easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set frequency easily with the Up/Down freq buttons and the big LED digital display. Plus there's input low pass filtering that gives great sound no matter what the source (no more squeals or swishing sounds from cheap CD player inputs!) Peak limiters for maximum 'punch' in your audio - without over modulation, LED bargraph meters for easy setting of audio levels and a built-in mixer with mike and line level inputs. Churches, drive-ins, schools and colleges find the FM-100 to be the answer to their transmitting needs, you will too. No one offers all these features at this price! Kit includes cabinet, whip antenna and 120 VAC supply.

We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.

FM-100, Professional FM Stereo Transmitter Kit	**$299.95**
FM-100WT, Fully Wired High Power FM Transmitter	**$429.95**

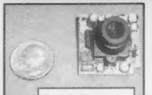
AM Band Radio Transmitter



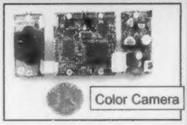
Ramsey AM radio transmitters operate in the standard AM broadcast band and are easily set to any clear channel in your area. Our AM-25, 'pro' version, fully synthesized transmitter features easy frequency setting DIP switches for stable, no-drift frequency control, while being jumper setable for higher power output where regulations allow. The entry-level AM-1 uses a tunable transmit oscillator and runs the maximum 100 milliwatts of power. No FCC license is required, expected range is up to 1/4 mile depending upon antenna and conditions. Transmitters accept standard line-level inputs from tape decks, CD players or mike mixers, and run on 12 volts DC. The Pro AM-25 comes complete with AC power adapter, matching case set and bottom loaded wire antenna. Our entry-level AM-1 has an available matching case and knob set for a finished, professional look.

AM-25, Professional AM Transmitter Kit	**$129.95**
AM-1, Entry level AM Radio Transmitter Kit	**$29.95**
CAM, Matching Case Set for AM-1	**$14.95**

CCD Video Cameras



B&W Camera



Color Camera

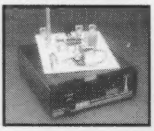
If you're looking for a good quality CCD board camera, stop right here! Our cameras use top quality Japanese Class 'A' CCD arrays with over 440 line line resolution, not the off-spec arrays that are found on many other cameras. You see, the Japanese suppliers grade the CCDs at manufacture and some manufacturers end up with the off-grade chips due to either cost constraints or lack of buying 'clout'. Also, a new strain of CMOS single chip cameras are entering the market, those units have about 1/2 the resolution and draw over twice the current that these cameras do - don't be fooled! Our cameras have nice clean fields and excellent light sensitivity, you'll really see the difference, and if you want to see in the dark, the black & white models are super IR (Infra-Red) sensitive. Our IR-1 Illuminator kit is invisible to the human eye, but lights the scene like a flashlight at night! Color camera has Auto White Balance, Auto Gain, Back Light Compensation and DSP! Available with Wide-angle (80º) or super slim Pin-hole style lens. They run on 9 VDC and produce standard 1 volt p-p video. Add one of our transmitter units for wireless transmission to any TV set, or add our IB-1 Interface board for audio sound pick-up and super easy direct wire hook-up connection to any Video monitor, VCR or TV with video/audio input jacks. Cameras fully assembled, including pre-wired connector.

CCDWA-2, B&W CCD Camera, wide-angle lens	**$99.95**
CCDPH-2, B&W CCD Camera, slim fit pin-hole len	**$99.95**
CCDPH-2, Color CCD Camera, wide-angle lens	**$149.95**
IR-1, IR Illuminator Kit for B&W cameras	**$24.95**
IB-1, Interface Board Kit	**$24.95**

FM Stereo Radio Transmitters

Microprocessor controlled for easy frequency programming using DIP switches, no drift, your signal is rock solid all the time - just like the commercial stations. Audio quality is excellent, connect to the line output of any CD player, tape deck or mike mixer and you're on-the-air. Foreign buyers will appreciate the high power output capability of the FM-25; many Caribbean folks use a single FM-25 to cover the whole island! New, improved, clean and hum-free runs on either 12 VDC or 120 VAC. Kit comes complete with case set, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized FM Stereo Transmitter Kit	**$129.95**



A lower cost alternative to our high performance transmitters. Offers great value, tunable over the 88-108 MHz FM broadcast band, plenty of power and our manual goes into great detail outlining aspects of antennas, transmitting range and the FCC rules and regulations. Connects to any cassette deck, CD player or mixer and you're on-the-air, you'll be amazed at the exceptional audio quality! Runs on internal 9V battery or external power from 5 to 15 VDC. Add our matching case and whip antenna set for a nice finished look.

FM-10A, Tunable FM Stereo Transmitter Kit	**$34.95**
CFM, Matching Case and Antenna Set	**$14.95**
AC12-5, 12 Volt DC Wall Plug Adapter	**$9.95**

RF Power Booster

Add some serious muscle to your signal, boost power up to 1 watt over a frequency range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM Stereo transmitters, providing radio service through an entire town. Runs on 12 VDC. For a neat, professionally finished look, add the optional matching case set.

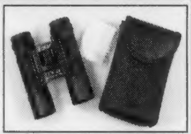
LPA-1, Power Booster Amplifier Kit	**$39.95**
CLPA, Matching Case Set for LPA-1 Kit	**$14.95**
LPA-1WT, Fully Wired LPA-1 with Case	**$99.95**

Treasure Finder Kit

Search for buried treasure at the beach, backyard or park. This professional quality kit can detect metal at a depth of up to 6 inches. Easy to use, just listen for the change in tone as you 'sweep' the unit across the surface - the larger the tone change - the larger the object. Has built-in speaker or earphone connection, runs on standard 9 volt battery. Complete kit includes handsome case, rugged PVC handle assembly that 'breaks down' for easy transportation and shielded Faraday search coil. Easy one evening assembly. This nifty kit will literally pay for itself! That guy in the picture looks like he found something - what do you think it is - gold, silver, Rogaine, Viagra? You'll have fun with this kit.

TF-1, Treasure Finder Kit	**$39.95**

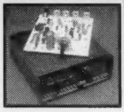
Binocular Special



We came across these nice binoculars in an importers close-out deal. Not some cheap in-line lens jobs, these beauties have roof prisms, a super nice rubber armored housing over light weight aluminum. 10 x 25 power with fully coated optics. Includes lens cleaner cloth, neck lanyard and nice carry case. For extra demanding use in bright sun, choose the EX module with ruby coated Objective lens. First quality at a close-out price! We've seen the exact same units with the 'Bushnell' name on them being sold for $30 more!

BNO-1, Binoculars and case	**$24.95**
BNO-1EX, Ruby Coated Lens Binoculars and case	**$29.95**

Speech Descrambler



Decode all that gibberish! This is the popular descrambler / scrambler that you've read about in all the Scanner and Electronic magazines. Speech inversion technology is used, which is compatible with most cordless phones and many police department systems, hook it up to your scanner speaker terminals and you're in business. Easily configured for any use: mike, line level and speaker output/inputs are provided. Also communicate in total privacy over telephone or radio, full duplex operation - scramble and unscramble at the same time. Easy to build, all complex circuitry contained in new custom ASIC chip for clear, clean audio. Runs on 9 to 15VDC. Our matching case set adds a professional look to your kit.

SS-70A, Speech Descrambler/Scrambler Kit	**$39.95**
CSS, Custom Matching Case and Knob Set	**$14.95**
SS-70AWT, Fully Wired SS-70A with Case	**$79.95**
AC12-5, 12 Volt DC Wall Plug Adapter	**$9.95**

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... and get with the program

On the cover: Eight-year-old Rebecca Rich KB0VVT of Raytown, Missouri, is the youngest Extra in the United States—as far as we know. She is the daughter of David KG0US and Barbara KG0UT. See "Hams With Class" column for more. Photo by the proud papa.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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NEVER SAY DIE

Wayne Green W2NSD/1

Anniversary

With this month, I'm finishing up 38 years of publishing *73*. Will we make it to a 40th anniversary? Darned few magazines do. And you know, never has the future of the hobby looked so desperate. The influx of newcomers has slowed way down. The nocoders are flat out not upgrading, so what few of us are left on the low bands are being mowed down by the smiling reaper. The ham industry is going broke, with even the largest firms hurting badly. Cushcraft, long a staple of the hobby, looks to me like it's blowing away.

With circuits so complex today, plus parts not being available, what was the heart of the hobby, building, has disintegrated. The Internet provides rag-chewing without QRM 24 hours a day anywhere in the world. Cell phones are handling most of the emergencies. All that doesn't leave much of a role for us hams. Plus, our only national organization seems far more interested in paying generous salaries and lavish travel expenses than in spending money to get youngsters interested in the hobby.

Meanwhile, we hams are deeply involved with trivia such as arguing over our many classes of licenses, the value of the code, and other baloney. Our bands are, in many cases, unfit for shortwave listeners to monitor. Our pioneering of new technologies pretty much died 35 years ago, when the ARRL put a stop to youngsters entering the hobby. Old men don't pioneer, they kvetch.

Then, in between now and September 2000, when we'll finish our 40th year, there's Y2K, that little millennial computer bug. I've more to say about that time bomb later. Of course, if we manage to survive Y2K as an operating society, we can always look forward to the other millennial disasters we've been promised. Sigh.

The Smaller Magazine

The rule of thumb in publishing is for magazines to be about half advertising and half editorial matter. The advertising revenues should normally pay half of the magazine's expenses, with the circulation paying the other half.

The recent downturn in both new General and higher-class licenses, which have been plummeting, and the catastrophic drop in new Technicians, have hit the ham industry hard. Sales aren't just down, they're way down. These are the times when the losers cut their advertising, thereby further reducing their sales. It's a downward spiral that I've watched before.

Back 25 years ago, when the ARRL petitioned the FCC to force around 80% or so of all hams to be relicensed in order to continue to use voice on the HF bands, the immediate result was a sharp drop in the sales of new equipment. This was predictably followed by the major ham manufacturers cutting their advertising budgets. So sales dropped even more, and they cut their ads more. And that's what happened to Hallicrafters, Hammarlund, National Radio, Gonset, B&W, and all the other big companies. They all committed marketing suicide.

When the times get tough, the tough get moving. When sales drop, you have to increase your advertising to bring in the sales and maintain market share. You'll find this advice in any textbook on advertising. Unfortunately, as far as I know, few (if any) of the major ham manufacturers have anyone in charge who has taken a course in advertising.

When I started my first company, manufacturing hi-fi loudspeaker enclosures, one of the first things I did was take a course in advertising. That's one of the best moves I've ever made. It was a superb course, put on by the Advertising Club of New York. With that know-how I was able to run circles around my competition and my enclosure soon was the largest-selling in the industry.

I suspect that you're going to see a replay of 25 years ago, with one after another of the ham industry giants blowing away, advertising to the last in *QST*, just as happened before.

Our reader surveys show that well over half of our readers aren't reading any other ham magazine, so advertisers that have dropped out of *73* have thrown away a big part of their potential sales.

Anyway, fiscal prudence dictates that we cut back on our pages to closer to 50/50 advertising and editorial. We survived the greatest disaster in the history of the hobby 25 years ago and we're planning to survive this one. If you talk with any ARRL members on the air you might urge them to put on the pressure for the League to start trying to promote amateur radio with the general public. I've gone into detail on how they can do this in the past, so I (for a change) won't repeat myself.

How bad was it 25 years ago? Before the ARRL petition to the FCC in 1963, we had over 850 ham stores carrying *73* on their counters. Two years later there were fewer than 150 ham stores left. I wonder if there are even 75 today. About the only ham manufacturers that survived the catastrophe were those advertising in *73*.

Retribution

The recent *Time* story on a California nursing home study was a shocker. But it merely confirmed what I've been reading in other reports on nursing home conditions around the country. So, when your parents have so destroyed their bodies that they can't care for themselves any longer, are you going to condemn them to a few years of torture in a nursing home? Where they routinely starve, dehydrate, and neglect the more helpless old people?

How about you? Will your kids dump you in a home once you have ruined your body and turned yourself into a virtual vegetable? Hey, that's way in the future, so why worry about it now? Let's see, will we go out for a Big Mac, KFC, or a pizza tonight? Better drink Diet Coke with it since you're 50 pounds overweight. Right?

I've forgotten whether it's 40% or 50% of us who are ending up in nursing homes, sitting there tied to a rocking chair, watching soap operas and Oprah until the laughing reaper calls to you through that long tunnel with the light at the end.

I've explained in my editorials and reprinted everything you need to know to stop getting sick and add many healthy years to your life in my *Secret Guide to Health* book. Hey, I'm in the same boat. I ate ice cream and desserts for over 70 years, so I know how difficult it is to change a lifetime of bad habits. I poisoned my body, dehydrated it, and avoided giving it the food it was designed to use. My folks taught me the same thing your folks taught you — you eat what everyone else is eating and when you get sick you go to the doctor and it's his responsibility to fix the problem you've caused.

The Brainwashing

My folks went to the Dutch Reformed Church, so that's where I went, too. My folks believed in the importance of going to college, so I went to college. I was so brainwashed — inculcated — with the beliefs of my parents that it took years before I began to be able to actually think for myself. And even longer before I was able to accept the responsibility for thinking for myself.

It was a long time before I was able to start considering the possibility that virtually all of the things I had accepted as truths all my life could be wrong. The process, for me, started with little things that didn't make sense when I looked into them. And the more I read and asked questions, the more holes I found in the fabric that had made up my life — that makes up all our lives.

Yes, I know, the League says we shouldn't discuss politics or religion on the air, and since most people have extremely solidified beliefs on these subjects, that keeps the heat down on the air.

As I read more and more about our diet, I had the problem of sorting out the more reliable information from the bogus. Whew! There's a lot of bogus information (opinion) out there. But the more I read, the more the pieces of the puzzle began to fit together.

The same thing happened when I began to research the education field. Plenty of baloney available there, too. But I found more and more experts that seemed dependable. Their information made sense and was backed by reliable research data. But what I found, as with diet, was nothing like what I'd been taught to believe by my folks. Or what we would be led to believe by our media and leaders. And this was what was behind my writing the *Secret Guide to Wealth*. If you are at all interested in making much money or in having a positive effect on the world, college will probably be a huge waste of your time and money.

This happened again when I started researching religion. An awful lot of people are going to have nothing further to do with me when I say that, as far as I know, not one true believer in the Bible or Jesus has ever bothered to read about the research that has been done into its origin. And, just in case I've left someone not thoroughly upset, the same goes for the Koran, the Torah, and the Baghavad-Gita.

God-Fearing

Every so often, I hear someone claim to be God-fearing. Where is this notion that God is going to punish us if we offend Him coming from? I've come to believe the basic idea is to love God and to love people, not to fear.

The time was when animal trainers did it by punishing the animals when they did wrong. That approach has been thoroughly discredited. The best animal trainers today work using love and understanding, not pain. In another hundred years or so, this message may even reach parents (and, I know you're not going to believe this, teachers) and get them to teach their children with love and understanding instead of punishment. Recent studies have conclusively shown that teen suicides are tied to childhood punishment. Sure, it's a lot easier to whack the kid when he's a nuisance than to love him. We let our anger and frustration get in the way of common sense and the result is a time bomb.

Since teaching through love and understanding is obviously nature's way, I just flat out don't believe that God doesn't use the same system He's built into His children — us and the animals. Many religions cement their power over their paying customers by threatening punishment from God. I love the long list of sins they've cooked up to keep people afraid, and continuing to pay. I also love the way the churches own so much of Manhattan and big chunks of property all around the world. Tax-free, of course.

My Aging Soap Box

So here I am, preaching to a mostly uninterested crowd, pleading with them (you) to start thinking — to start investigating all of the things you believe to see if they are really true. Is the food you're eating and drinking making you sick and killing you years before your possible lifespan should end? Do the keys to the kingdom of God lie in the hands of the clergy or in yours? I've mentioned that every well-researched book on near-death experiences tells us that the people who have died and come back from "heaven" all have a similar story. They agree there is a force we call God. But they almost all give up going to church or belonging to any organized religion.

If I can get you to break away from the accepted mass beliefs — belief in the food you're eating, our school system, our religions, etc. — perhaps I can then convince you of the power of one. The power that one person can have to improve the world.

The Power of One

When I got interested in repeaters I saw them as an exciting new technology. I also saw them as a possible solution to get amateur radio going again after the so-called "incentive licensing" catastrophe — where almost 90% of our ham stores went out of business in a couple of years and ditto our manufacturers. That was the worst disaster ever to hit our hobby and it was caused primarily by millionaire Mort Kahn W2KR,

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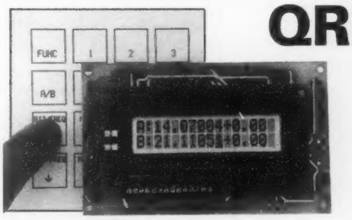

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LETTERS

From the Ham Shack

Kirk Ellis KK4YP, Massillon OH. I really enjoy reading *73*. Liked reading "Techno-Trouble II" in the June issue. However, Mr. Katz was mistaken on one of his geography questions and answers (# 25). Being a native North Carolinian, I would like to point out that there are a number of mountains, in both North Carolina and Tennessee, higher than Mt. Washington, New Hampshire, which is not the highest point east of the Mississippi River.

That honor goes to Mount Mitchell, NC, at 6684 feet above sea level (named for an explorer who fell to his death trying to prove it the highest mountain in the eastern US), versus 6288 feet for Mt. Washington.

Also, a few others higher than Mount Washington: Clingman's Dome, Tennessee, at 6643 feet; Mt. Guyout, also in Tennessee, at 6621 feet; Mt. Le Conte, Tennessee, at 6593 feet, and Richard Balsam Mountain, in North Carolina, at 6540 feet. Mt. Mitchell has a state park at the top and offers a great place to work DX and contests, especially on six meters and above!

Thanks for a great magazine — it keeps me thinking. I really look forward to receiving it each month — and don't change your editorials. I have ordered many of the books you recommended. I am an engineer with a PCS cell phone company and also run two of my own part-time businesses (RF consultant and test equipment sales), which I hope will one day become full-time.

Your editorials have made me think, and made me decide it's time to broaden my knowledge of things other than just ham radio and electronics, where I have been spending a lot of my time reading and studying for the past 20 years.

The mind is like a muscle – you either use it or lose it ... Wayne.

Dick Clark K6GLB, Gig Harbor WA. I have neither heard nor read of you since my subscription to *CD Review* expired. I admit I miss your commentary, because, on so many topics, I found myself in agreement with your philosophy. Not only that, I have tremendous admiration for those who had the courage to volunteer in the Silent Service and who contributed in such a great way to defeating the Japanese by sinking over 55% of their shipping.

I was fascinated by your comments about our voyages to the Moon. Like Art Bell W6OBB, I am skeptical of your analysis, but your facts are indeed interesting. I certainly hope you are wrong; however, you are one of the few people who have the credibility to draw serious attention to this issue.

I earned my Novice license in 1953, and then Technician, and upgraded to General in the early '60s. Then the ARRL pushed "incentive licensing" down our throats and took away some of my hard-earned privileges. That was the end of my relationship with the ARRL—and I have agreed with every editorial you have written on that subject, including the code requirements for licensing. The ARRL is the best friend of the communications industries, who want to expand their usable range of frequencies at the hobby's expense. Unfortunately, because the hobby is dying and our only representative is contributing to its demise, industry will probably win a substantial chunk of band allocations. Twenty years from now, just how many hams will there be? They will probably be outnumbered by employees at the FCC.

Jerry Mulberg W2MJP, Riverdale NY. Keep up the good work on your timely "Never Say Die." It is most interesting and informative, besides being excellent on subjects other than ham radio. We all appreciate your excellent column about everyday living and breathing. We need more guys like you with your look to the future about so many aspects of everyday living.

Jerry, your letter came in the same mail as W3ZC's. [See last month.] Considering that most people only write to an editor when they have a beef, one thing that keeps me not just going, but happily going, is the number of letters like yours that the readers bother to write. Now that I'm not bogged down running seven magazines a month, or trying to cope with my chain of computer software stores, or with producing CDs, I've been spending most of my time looking for information that will help people to live better lives. Yesterday I ordered 38 books from Barnes & Noble which have been recommended by my readers and some experts I've come to respect. That's a lot of homework to do, and then to report on, but I don't know of any other magazine anywhere that provides such a wide variety of information ... Wayne.

Richard Donovan AC5OD & Robert Thompson KF3L. Three cheers for the ultimate old wheezer, our steely-eyed rattler of cages and square-jawed eater of tornadoes, Wayne Green. This cantankerous old curmudgeon, a true crotchety crustacean on crusade for truth and light in amateur radio, represents the true ham spirit with the blaring voice of a rusty foghorn.

While others parrot the party line, pretentiously lock-stepping in their tiny-mindedness, our fearless leader, a true geezer among geezers, exposes these Lilliputians for what they are, that is, mindless and soulless robots whose main desire is to have control over everyone.

We will be safe from harm for as long as our hero treads the oceans and continents of this troubled planet, carefully sandpapering flat the faces of the stoneminded, self-proclaimed "Radio Elite." Our true hope is that somewhere within the increasing QRM, a budding diamond in the rough is ripening on the vine, ready to follow in his footsteps.

One day, our iconoclastic voice in the night will depart this earthly QTH, leaving us all poorer as a result. So keep on keeping on, Wayne, we're behind you. If you didn't exist, we would have had to invent you.

Aw, shucks. By the way, I eat tournedos (slices of beef), not tornadoes. I've been waiting for years for an heir (hair?) apparent to start sending me publishable editorials. My in basket flourisheth not with such ... Wayne.

James Long, Ph.D., P.E., Sunnyvale CA. The new analog wall clocks by ZEIT bring new meaning to the phrases "A day late and a dollar short" and "Hay is always cheaper after passing through the horse."

All the cutesy inconvenience features (that cannot be defeated by the user) that were condemned by a *QST* review of the digital-readout desk model have been carried over into the analog model.

The cumulative effects of gravity, dead zone, dial misalignment, and gear eccentricity produce plus or minus one minute error in the reading of the minute hand during different parts of the hour.

The clock is not continuously synchronized to an atomic standard as stated in the *QST* advertisement. It is a

Continued on page 62

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QRX . . .

"Young Ham of the Year" Shares His Award with Children in Need

A 16-year-old from Florida has surprised the ham radio community by donating part of his award as *Newsline* "Young Ham of the Year" to the "Make A Wish" Foundation. Richard Paczkowski, Jr. KF4BIA, of Edgewater, Florida, says that he donated his week at Spacecamp Huntsville to the organization so that a less fortunate youngster can enjoy his or her dream:

"What I would like to do, if possible, would be to donate my week at Spacecamp to the 'Make a Wish' Foundation. As you know, children with life-threatening illnesses are signed up with the organization and 'Make a Wish' tries to make their wish come true," said Paczkowski.

"I am sure that there is a little kid, somewhere, who really wants to go to Spacecamp. It would give me a lot more joy to know that there is one little kid out there for whom going to Spacecamp is his great wish, and have it come true."

The week at Spacecamp is a part of the "Young Ham of the Year" Award, underwritten by *CQ Magazine,* of Hicksville, New York. *CQ's* Advertising Manager, Arnie Sposato N2IQO, says that he is very impressed by Richard's generosity.

"It's really such a nice gesture and very commendable on his part to make such an offer. It is a wonderful thing that Richard is doing," said Sposato.

***Photo A.** 16-year old Richard Paczkowski Jr. KF4BIA, 1998's "Young Ham of the Year."*

Also delighted by Richard's generosity was Yaesu USA's Director of Sales and Marketing, Kevin Karamanos WD6DIH. Yaesu is another of the "Young Ham of the Year" Award corporate sponsors. Karamanos believes that Paczkowski has set a new standard for those who will follow.

"I should not be shocked because of the caliber of people who are selected to receive this award; it's only that I have never heard of anyone doing this, and it is such a great idea. It's just super!"

Richard Paczkowski Jr. was named the 1998 "Young Ham of the Year" based on his four-year amateur radio career, dedicated almost exclusively to public service work, including organizing local county communications support during the recent Florida wildfires.

In her letter nominating Richard for the award, Patricia White N6LKC/4, stated: "This young man deserves this award because of his outstanding dedication in serving his community at times of need and distress ... With his active and 'beyond the call of duty' attributes, he has successfully and honorably used amateur radio in the light with which it was meant to shine ... This fine young man is the representation of what amateur radio is all about and was meant to be."

Richard Paczkowski Jr.'s decision to donate his trip to Spacecamp to a seriously ill child more than reinforces Mrs. White's words. It shows him to be a young man of compassion for, and understanding of, the needs of those less fortunate. He will receive his award the evening of August 15th, 1998, at the Huntsville Hamfest in Huntsville, Alabama.

TNX Bill Pasternak WA6ITF, editor of *Amateur Radio Newsline.*

ARRL Proposes Simplified Licensing

The ARRL Board has agreed to propose a simplified Amateur Radio licensing structure with four classes. Lengthy discussion and debate during the board's meeting July 16–18 led to majority support for a plan for four written examination elements to establish amateurs' operational and technical qualifications instead of the present five, and two Morse code examination elements instead of the present three.

Under the plan adopted by the board, the entry level to amateur radio would be known as "Class D" and would convey the privileges of the present Technician license. The written examination would be at the same level of difficulty as that of the present Technician examination, and consistent with the privileges of the license. All amateurs now licensed as Technicians would become Class D.

The next step would be known as "Class C" and would convey the privileges of the present General license, but with phone subbands expanded by 50 kHz on 75 and 15 meters and by 25 kHz on 40 meters.

Class C would be the entry level to high frequency (HF) operating privileges. To upgrade from Class D to Class C, an amateur would pass a written examination on the operational and technical qualifications required for HF operation and a 5 WPM Morse code examination. All amateurs now licensed as General, Technician Plus, and Novice would become Class C. The expansion of the telephony subbands would result from "refarming" of the Novice CW bands that are no longer required for their original purpose.

The third step would be known as "Class B" and would convey the privileges of the present Advanced license, but with phone subbands expanded by 50 kHz on 75 and 15 meters and by 25 kHz on 40 meters. To upgrade from Class C to Class B, an amateur would pass a more advanced written examination, similar in difficulty to the present Element 4A and a 12 WPM Morse code examination. All amateurs now licensed as Advanced would become Class B.

The final step would be known as Class A and would convey the full privileges of the present amateur Extra Class, with telephony subbands expanded by 50 kHz on 75 and 15 meters and by 25 kHz on 40 meters. To upgrade from Class B to Class A, an amateur would be required to pass the most difficult written examination in the sequence. Consistent with the practice in many other countries, no additional Morse code examination would be required beyond 12 words per minute. All amateurs presently licensed as Extra Class would become Class A.

In their discussions, board members emphasized that the objective is to rationalize and simplify the amateur licensing structure without reducing the requirements for any class of license. Where reductions in Morse code requirements are proposed, there would be a corresponding increase in written examination standards. On the other hand, board members were adamant that simplifying the structure should not come at the expense of privileges already earned by amateurs. Therefore, present Novice and Technician Plus licensees, having earned entry-level HF operating privileges, would be granted the new entry-level HF license.

Adoption of the simplification plan marks the culmination of 30 months of work by the board, during which time the input of literally thousands of ARRL members and other amateurs and prospective amateurs was considered. The board debated a wide variety of options, including both smaller and larger numbers of license classes, higher and lower qualification levels, and different privileges. Nine of the 15 directors voted in favor of the plan, with six opposed. Following the

Continued on page 59

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MFJ's *automatic notch* filter searches for and eliminates *multiple* heterodynes.

You also get MFJ's advanced *adaptive noise reduction*. It silences background noise and QRN so much that SSB signals sound like FM.

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It works on *all modes* -- SSB, AM, CW, FM -- and frequencies from BCB to lower VHF.

You can null out strong QRM on top of weak rare DX and then work him! You can null out a strong local ham or AM broadcast station to prevent your receiver from overloading.

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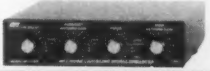

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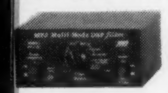

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What do you get when you mix two empty aluminum cans, a couple of empty toilet paper tubes, and a germanium diode? The Ultimate Green Radio!

Although the accompanying photo may raise a few eyebrows, this is no joke. The unique crystal radio described in this article really works! It's a little tricky to tune, but it is super selective and loud. And it has, of course, all the attributes of a crystal radio: It receives standard AM broadcasts, has no active components, and requires no power whatsoever! All it requires is a good antenna and a pair of high impedance headphones (2000 Ω or better). You'll be hard pressed to find any other electronic device as environmentally friendly, so I've named it The Ultimate Green Radio.

Another appealing attribute of this unique crystal radio is that virtually all the parts can be salvaged from waste artifacts found in the average home. The crystal radio described in this article was built completely from salvaged parts and common household items except for the germanium diode (12¢) and two Fahnestock clips (11¢ each).

The unique aspect of the UGR is its homemade aluminum can variable capacitors. Normally, air dielectric variable capacitors, with their elaborate meshing plates and ball bearing shafts, are used. Such variable capacitors are both expensive and difficult to find. I developed the aluminum can variable capacitors to solve the availability and cost problems. They replace $30 worth of the traditional air variable capacitors, at the cost of the deposit value of two empty aluminum cans—and provide a great example of recycling ancient

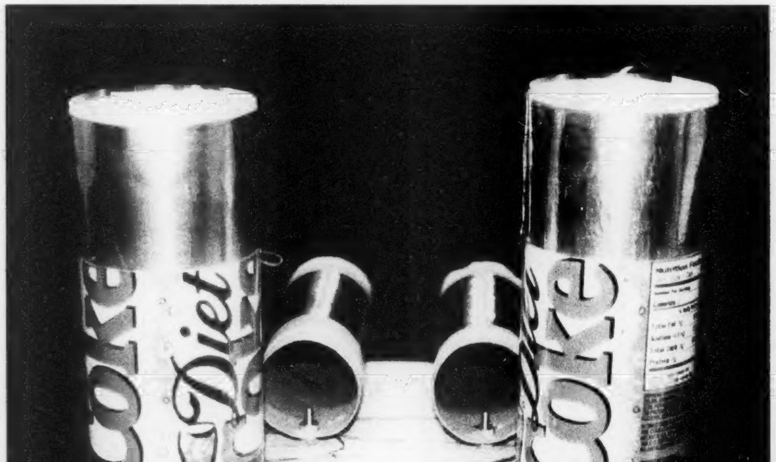

Photo A. *Finished—and ready to start listening to the radio!*

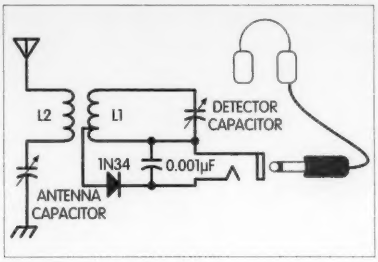

Fig. 1. Schematic for the Ultimate Green Radio.

technology: They're really a variable capacity version of the granddaddy of all capacitors, the Leyden jar (circa 1745).

The crystal radio is almost as old as radio itself. Although it may be basic ancient technology, the crystal radio has launched more engineering careers than any other single electronic project. I built my first crystal radio in 1942. It was my Aladdin's lamp—my first solo experience with science—and it launched my engineering career that spans over 40 years. Therefore, the UGR is an ideal project to share with a youngster—it's inexpensive, it involves no hazardous voltages, and it demonstrates many electronic principles (inductance, capacitance, resonance, detection, etc.). It also illustrates something very important to young minds: Complex modern technology is just the resourceful integration of basic concepts and components, incorporated into the simple crystal radio. And, of course, the UGR also demonstrates a direct approach to recycling.

About the circuit

The basic circuit (**Fig. 1**) used for the UGR was developed in the 1930s by Elmer G. Osterhoudt 6NW, a well-known ham operator and prolific inventor. The circuit incorporates an antenna tuner, inductive coupling between the antenna tuner and the detector tuned circuit, and a germanium diode tapped into the low (or cold) end of the detector coil to keep the headphones from swamping the tuned circuit. This design ensures optimum transfer of energy from the antenna system and produces very sharp selectivity.

Gathering materials

Bathroom wastebaskets generally contain one or more empty toilet paper tubes. The family recycling bin will likely produce a couple of empty aluminum beverage cans. A small piece of pine board can be salvaged from an old packing crate or from the trimmings pile at a local lumberyard. A couple of discarded overhead projector transparencies (view foils) can be plucked from your office wastebasket. Items such as magnet wire, germanium diode, 2000 Ω headphones, Fahnestock clips, solder lugs, etc., are probably lurking in your junk box (we hams are pioneers in recycling!). Whatever you're unable to scrounge, you can purchase at a local ham swap meet, Radio Shack™ or Antique Electronics™.

Winding the coils

Coil winding is a unique experience and can be quite frustrating if you do not have good vision and a steady hand. Allow yourself about 20 minutes to wind each coil. Once you begin winding, consider yourself committed to finishing the task. Find a time when you will not be interrupted. Begin by marking the toilet paper tubes (a/k/a coil forms) as depicted in **Fig. 2**. Make the mounting holes first, then make the small holes at either end to secure the wire by threading it through the holes at the beginning and end of the coil. When winding the wire around the tube, try not to overlap previous windings; keep them side by side and close together. Since the cardboard tubes are quite thin, be careful not to squash them while handling (however, keep the windings tight on the tube). Once wound, cellophane tape can be wound around the ends of the windings for a little extra security.

Dealing with the tap on the detector coil: The tap is formed by making a hairpin loop (about three-quarters of an inch tall), then twisting it together a couple of times. After the tap is formed, continue winding the rest of the coil. After the coil is completed, carefully scrape the enamel coating off the twisted tap, using a pocket knife or fine grit sandpaper. It is necessary to remove the enamel from the tap to expose the bare copper. This will allow you to solder a wire to the tap. Go easy with the scraping so that you do not cut through the wire—just remove the enamel coating. The enamel must also be removed from the ends of the coils so they can be soldered during assembly.

Producing the aluminum can variable capacitors

Select two undented, non-sticky aluminum cans. Inspect the transparencies: They must not be wrinkled or punctured. Cut the transparencies exactly five inches by 11 inches, and the aluminum foil tape exactly two inches by nine inches (use a paper cutter if you have access to one).

Carefully wrap the transparency tightly around the can, and be sure that any printing on the transparency faces

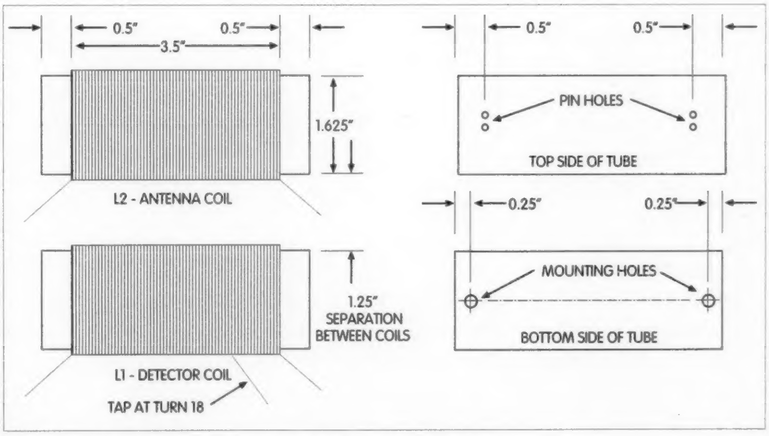

Fig. 2. Coil specifications for the Ultimate Green Radio.

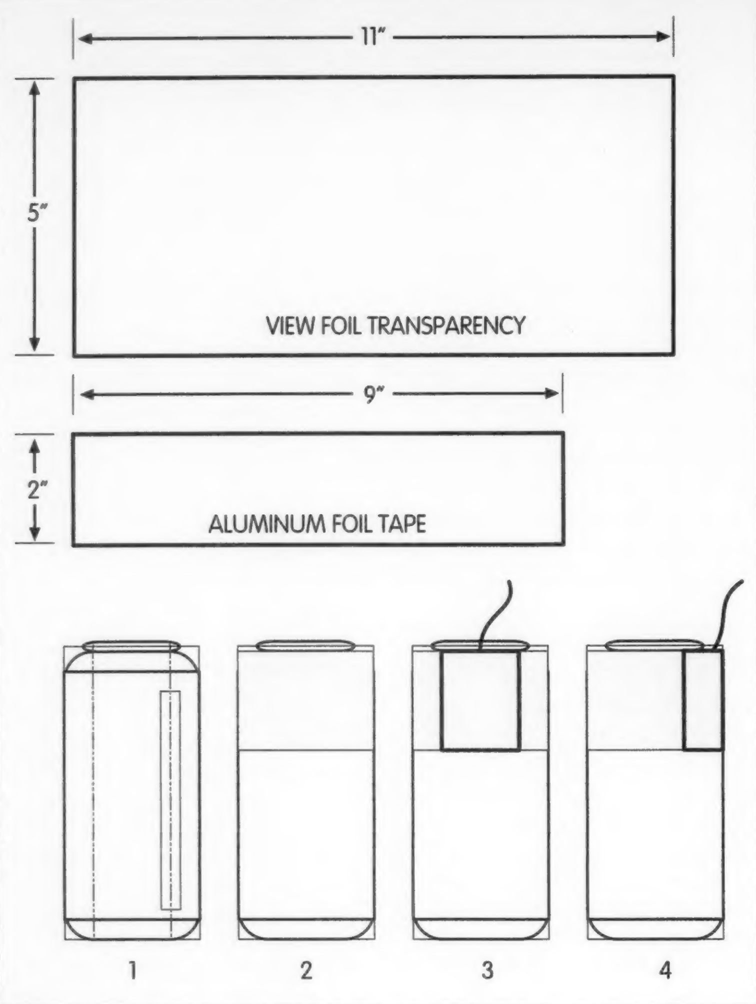

Fig. 3. *Wrapping the transparency, making the desoldering-braid contact, and holding everything down with the aluminum tape.*

outward. The transparency will overlap itself a couple of inches. Set the can upright on a flat surface, and while holding the transparency onto the can to keep it from unwinding, slide the wrapped transparency down until it touches the flat surface. Make sure that the bottom of the transparency is square and flush with the flat surface. Now, tape the wrapped transparency where it overlaps, using cellophane tape (**Fig. 3-1**).

I found it useful to apply the aluminum tape by temporarily placing the transparency sleeve onto a full unopened can (and you can return the unopened can to the refrigerator when you have finished). Before applying the aluminum tape, turn the can sideways, then slip the transparency sleeve down the can so the top three inches of the sleeve are below the shoulder of the can. Wrap the tape around the transparency sleeve so that the top of the aluminum tape is about one-quarter inch from the top of the transparency sleeve (**Fig. 3-2**). You are now ready to install the electrode for the aluminum tape.

Connecting to the aluminum foil

A piece of desoldering braid is used to make electrical contact with the aluminum foil. This contact will be completely frictional, so make sure that it is a good, tight physical contact. Prepare 12 inches of braid and attach it to the aluminum foil tape using another piece of aluminum tape (approximately three inches long) to hold it in place (**Figs. 3-3** and **3-4**). Now check to be sure that the completed transparency sleeve slides freely up and down on the can, but that it is tight enough so it will remain in position once it is set. Repeat the process for the second aluminum can variable capacitor.

Mounting the parts

The original UGR was built on a piece of lumber salvaged from an old packing case. It is nine inches wide, eight inches deep, and three-quarters of an inch thick. Any size board will work as long as it provides enough space for the aluminum can caps and two coils. The coils are mounted using 1-1/2 inch #6 x 32 bolts and nuts. All other parts are fastened using small screws, as shown in **Fig. 4**.

Parts List

Qty.	Description
L1, L2	115 turns each of #22 gauge enamel-covered magnet wire (RS# 278-1345)
2	empty aluminum beverage cans
2	overhead projector view foils (new or used)
22"	2"-wide aluminum foil tape
10"	3/4"-wide transparent cellophane tape
38"	desoldering braid (RS# 64-2090)
1	.001 μF fixed capacitor (RS# 272-126)
1	1/4" phone jack (RS# 274-252)
1	1N34 germanium diode (RS# 276-1123)
Pine board, 9" x 8" x 3/4" (approximately)	
Miscellaneous hardware; nuts, bolts, screws & solder lugs	

Table 1. *Parts list. For L1, a tap is placed at turn 18 of 115 turns of wire. The windings occupy 3-1/2 inches. For L2, 115 turns of wire are closely spaced and occupy 3-1/2 inches. A total of approximately 105 feet of wire is needed for the coils.*

Attaching the aluminum can variable capacitors to the board requires a little ingenuity. The aluminum cans are mounted by carefully punching a hole in the bottom of the can, then feeding a screw through the opening in the top of the can and into the hole. Before tightening the screw completely, place a seven-inch piece of desoldering braid beneath the can to make electrical contact with the bottom of the can (the braid should extend beyond both edges). The screw is then tightened into the wood to mount the can and to make good electrical connection between the bottom of the can and the desoldering braid (see **Fig. 4**).

Soldering

Solder lugs are cheap and readily available, and I recommend that you use them. When soldering the germanium diode (1N34), be careful not to get the diode any hotter than necessary. If possible, have someone grasp the lead of the diode (between the solder joint and the diode body) with a pair of long-nose pliers while the part is being soldered. This will draw the heat away from the diode and into the pliers. If you don't have anyone to assist you, wrap a rubber band around the handles of a pair of long-nose pliers (to keep the jaws closed), and then connect the pliers between the solder joint and the body of the diode. When soldering, be very careful that the soldering iron does not touch the transparency sleeves. It doesn't take very much heat to ruin them.

About headphones

There is really no substitute for a good pair of high impedance headphones (2000 Ω or greater). A good pair of headphones will last a lifetime. Ham flea markets are a good place to buy used headphones (but be sure they are at least 2000 Ω). New phones are available at Antique Electronics; call (800)-706-6789.

About antennas

The better the antenna, the better the crystal radio will work. This crystal radio functions entirely upon the very small voltages induced into the antenna by the signals transmitted by the radio stations. Make the antenna as high and long as you can. An antenna 100 or more feet long is recommended. You can hang the wire from trees, between houses, or from almost any available support. If you intend to use an amateur dipole with the UGR, keep in mind the following: If the antenna contains a balun, it will have to be bypassed. If it is fed directly with coax, tie the braid and center conductor together. For good reception, at least a 40-meter dipole fed with open line will be required. Remember, a half-wave antenna for the BC band is about 500 feet long!

For best performance a crystal radio should have a good earth ground. This can be accomplished by connecting the ground connection of the UGR to a pipe driven three or more feet into the ground, or to a nearby cold water pipe (assuming you have metal plumbing!).

Operating the Ultimate Green Radio

The UGR is a little tricky to tune. This is because:

- Both the antenna and detector tuned circuits must be tuned to the same frequency;
- The tuning process itself is skill-intensive (not unlike playing the trombone);
- Both the antenna and detector circuits tune very sharply. It just takes a little practice. Keep in mind that the aluminum can variable capacitors track very closely. For example, if a station is located near the high-frequency end of the band, both of the transparency sleeves will extend well above the top of the cans, and about the same amount. As stations lower in frequency are tuned, the sleeves will be proportionally lowered onto the can. The aluminum can variable capacitors are adjusted by grasping the transparency sleeves below the aluminum foil, and carefully and slowly moving them up or down.
- To help manage the friction between the can and the sleeve (thereby enhancing fine adjustment) slowly rotate the sleeves back and forth about an inch while moving them up and down.

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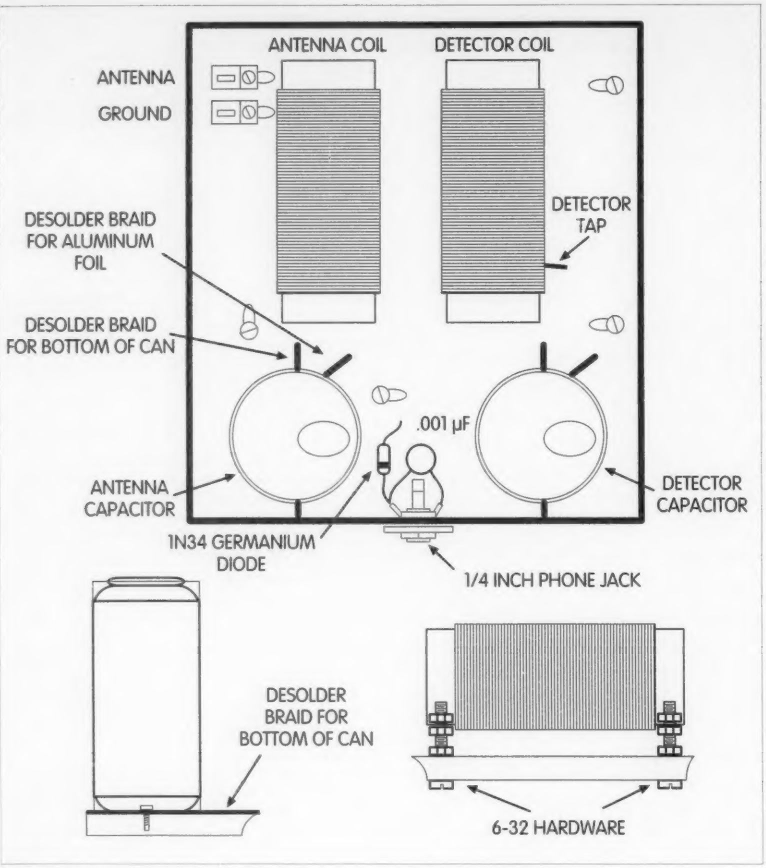


Fig. 4. Parts identification, mounting, and wiring information.

Unlike most radios, the UGR does not have dials for logging stations. However, you will be able to produce a log by using the printing on the can to index the position of the bottom of the foil. The Nutritional Facts label on the side of the can works well for this purpose.

Okay, let's try it. Attach the antenna and ground to the UGR. Connect the headphones and put them on. Place both transparency sleeves so that the bottoms of the aluminum tape are even with the shoulders of the cans. Now, carefully—and very slowly—move both of the transparency sleeves downward at the same time and at the same rate. In this way they will be roughly tuning to the same frequency as they move down the can. Once you hear a station, leave the antenna capacitor sleeve where it is and carefully tune the detector sleeve for the maximum volume. Once you have done this, carefully tune the antenna sleeve for maximum volume. You may have to jockey back and forth between the two capacitors until you get it just right. After you get a station tuned in, check the position of the bottom of the aluminum tape on the detector capacitor and log its position relative to the printing on Nutritional Facts label. Continue this process as you move the sleeves down the can. Once you have gained the tuning skills, it's a lot of fun to tune.

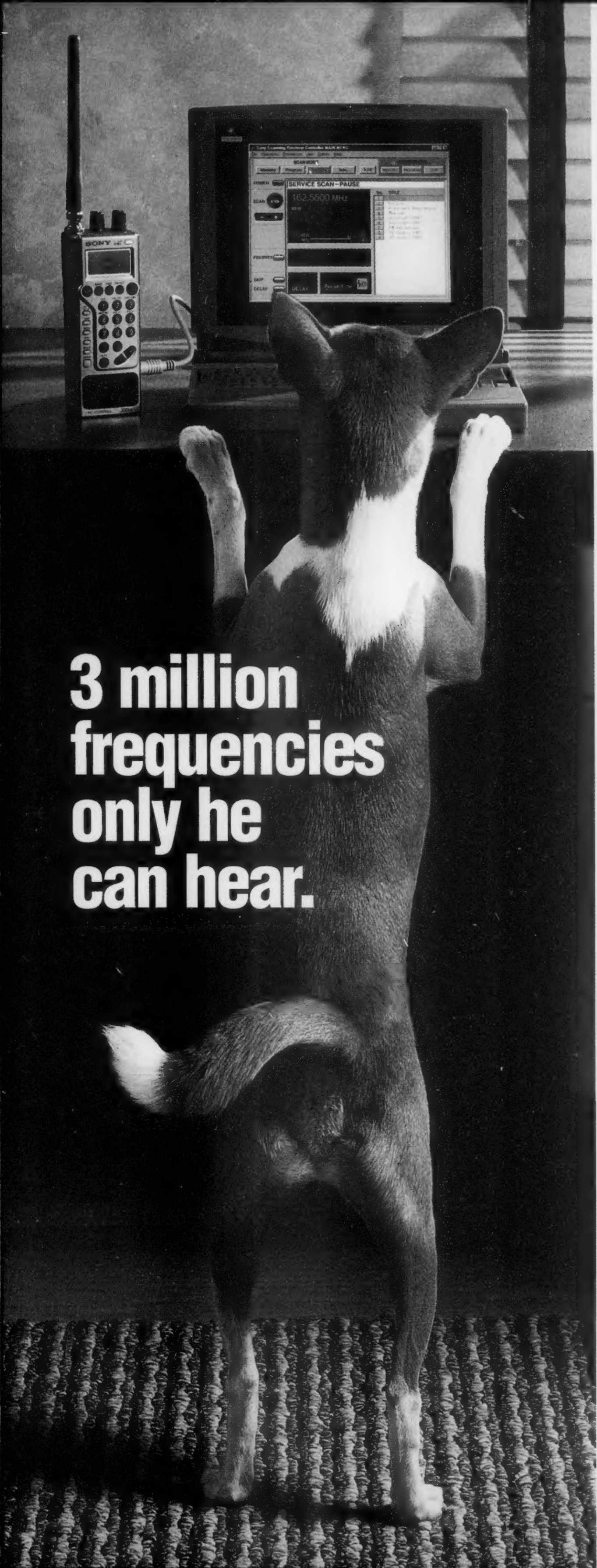
The Ultimate Green Radio, although a low-tech, low-budget project, illustrates a number of important concepts—especially from an environmental perspective. With our landfills overflowing, the ozone layer perforated, and our air and water polluted, the message is clear: We must learn to be less wasteful and careless, and try to find innovative ways to clean up our planet and keep it that way. The Ultimate Green Radio, with its straightforward display and utilization of waste artifacts, is an ideal instructional aid to stimulate creative recycling solutions—and might cause us to take another look at items we classify as "trash."

Another important message is that older technology is, in many cases, superior to modern technology in terms of simplicity, efficiency, and environmental impact. The simple crystal radio described in this article is constructed almost entirely of household waste, yet it is a fully functioning radio with wonderful fidelity and selectivity, and it operates at an efficiency unmatched by modern technology. And best of all, anyone can build one—even an eight-year-old (with a little loving guidance from grandpa).

Typical Antenna Installation

Try to get your antenna as high and long as possible, but keep it away from power lines. Nylon ties make excellent insulators; they are strong, light and inexpensive. You can use a the bungee cord to keep the antenna taut and prevent it from breaking during windy periods. While most wire sold as antenna wire is bare copper, #18 gauge stranded copper insulated wire is easier to work with and will last for years. The color of the insulation can be selected to make the wire nearly invisible.

An earth ground can be made by driving a metal rod or pipe at least three to four feet into the ground. The best way to accomplish this is to purchase a ground rod of the type used by electricians for grounding the electrical service, which are available at most well-stocked hardware stores. If your home is plumbed with metal pipe, a cold water pipe also can be used. The best way to make connection to the ground rod or cold water pipe is to use a ground clamp. They are readily available at hardware stores, too.



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What's the Scoop on the Lazy Loop?

Here's how multiband wire antennas measured up in real-world comparisons.

Ed Van Overloop WA2UGT
106 N. Fifth Street
Park Ridge NJ 07656-1024

Twenty years ago, I installed my first 80-meter full-wave horizontal loop antenna, called "The German Quad" by DF3TJ in his article (*73 Magazine*, June 1978). Since that time, I have continuously used this type of antenna as a standard of comparison for all other antennas used at my QTH. Although several construction and computer analysis articles have been written about full-wave horizontal loop antennas, there has never been an article in which the real-world performance of these antennas was compared to other wire antennas. In this article, I will try to share what I've gleaned from my many years of antenna experience.

For the record, my QTH is located in northern New Jersey, and is approximately 300 feet above sea level. My square, coax-fed, 80-meter loop is located approximately 40 feet above the ground. I also have a pentagonal 160-meter full-wave loop, fed with 450-ohm open-wire, at approximately 60 feet of elevation.

I have used my horizontal loop antennas for many years, enjoying thousands of contacts with amateurs who used a large variety of antennas, and have had hundreds of in-depth discussions with other hams who use loop antennas. Both of my loop antennas are solid performers on their fundamental frequency, and the 80-meter version provides excellent performance on eight amateur bands (10–80 meters).

I am a casual DXer and an avid ragchewer, and my two loops have helped me to earn WAS and WAC on all HF bands. I also have more than 100 countries confirmed on each of six HF bands, and over 60 countries on each of the rest. One highlight on 160 meters was an "S-7" from a VK5, in southern Australia, 10,000 miles from my QTH. He reported that my "cloud warmer" was giving him the only signal he could hear well enough to work at that time.

The following advantages have been noted by most users of horizontal-loop antennas:

- •Better than average performance on all HF and SWL bands.
- •Simple, low-cost installation which does not require traps, baluns, or tuning and pruning. Just install it according to the measurements in **Table 1**.
- •The antennas are inconspicuous, and provide good performance at lower heights than most other wire antennas.
- •SWR of less than 3:1 (see **Fig. 1**) at some point in every HF band, allowing the built-in automatic antenna tuners in most new HF rigs to provide a proper power transfer to the antenna.

Continued on page 18

Band	Length of Each Side	Total Length of Wire	Minimum Height Above Ground
40 m	35 feet	140 feet	20 feet
80 m	70 feet	280 feet	40 feet
160 m	135 feet	540 feet	60 feet

Table 1. *Construction details for full-wave multiband horizontal loops.*

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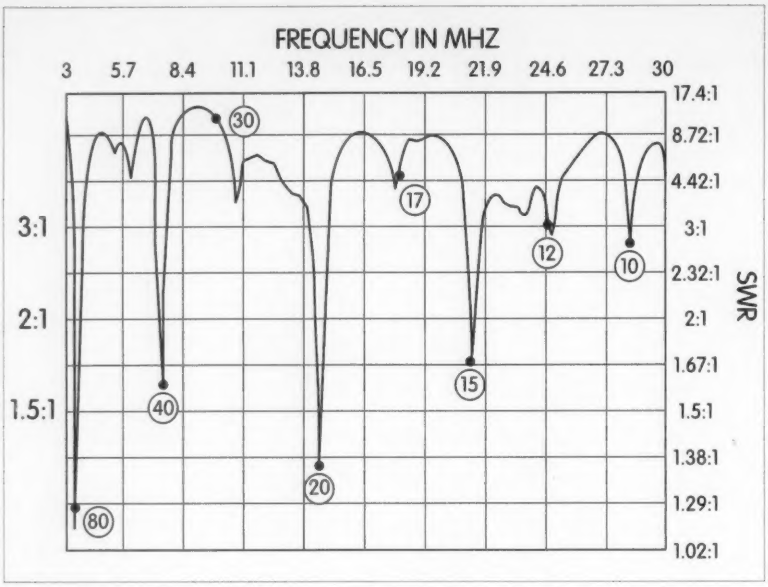

Fig. 1. All bands chart. Relative SWR vs. frequency for the 80 m loop, as measured with a Hewlett-Packard 3577A Network Analyzer.

- Some noise cancellation, due to the closed-loop design, when compared with open-ended type antennas.
- High-Q with low feedpoint impedance (20 to 200 ohms) and good bandwidth.
- Large capture area with less QSB or fading.
- High efficiency with 3- to 18-dB apparent gain over other simple wire antennas.

There are few disadvantages, and these are usually related to the individual preferences of the owner or the physical constraints created by his location. The disadvantages most often mentioned are:

- Large size (up to 140 feet per side, and 200 feet diagonally, for the 160-meter version).
- The need for four conveniently-placed tall supports.
- Some sort of inline tuner is necessary.
- The radiation pattern is more or less omnidirectional.

About a decade ago, I gave an antenna lecture at a local radio club. During the question-and-answer phase, I was given a friendly challenge to prove my statement that an 80-meter horizontal loop provided good DX performance on the 75-meter phone band. That challenge lead to a series of real-world comparisons of loops, single- and multiband wire antennas, and a couple of beams. I hope that reporting these actual results will dispel the commonly-accepted myth that horizontal loop antennas, at their fundamental frequencies, are cloud warmers useful only for local contacts.

Several local hams agreed to join in the antenna tests. During the first test, we were all located within five miles of each other, each had his antenna in the clear, and our elevations were all between 200 and 300 feet above sea level. To keep the results as fair as possible, we all agreed to use a power level of only 100 watts. My antenna was the 80-meter loop at a height of about 40 feet above the ground, test antenna #1 was a 75-meter dipole at 60 feet above the ground, and test antenna #2 was a 75-meter inverted vee at approximately the same height.

Our first contacts were with hams located 75 to 100 miles from Park Ridge (New Jersey). We found the loop to have as much as a 40 dB advantage over the dipole and inverted vee, proving that the loop certainly does have considerable high-angle radiation. Next, a group of five hams scattered around the Midwest volunteered to help in our tests.

Rank	Antenna Type (mounted at 40 feet)	Performance Characteristics:			
		Ground Wave	Short Skip	Long Skip	Short Term Fade
1	Full Wave 80 m Horizontal Loop	fair	excellent	good–excellent	very good
2	Centerfed Zepp	poor	very good	fair–good	poor
3	Inverted "L" (130 feet long)	good	good	fair	good
4	Windom	fair	very good	fair	poor
5	Multiband Trap Dipole	poor	very good	fair	poor
6	G5RV	poor	good	poor	poor
*	2-Element Multiband Quad	very good	good	excellent	very good
*	Trap-Type Triband Yagi	good	fair	good–excellent	fair
*	Half Wave Vertical	excellent	fair–good	good	poor

***Table 2**. Wire antennas, ranked by all-around performance. (*) indicates the antenna referred to is not a wire antenna; used for comparison only.*

The transmitted signals from the loop averaged one and a half S-units better than the other antennas. On that static-prone night, my receive capability was Q-5, while my friends were having some trouble copying the Midwest stations through the static crashes. West Coast stations who had been following the test from a distance of approximately 3,000 miles agreed that the signal from the loop had a one S-unit advantage over the dipole and inverted vee.

We then turned our attention to Europe and beyond, working stations up to 5,000 miles away. We contacted hams in several different countries, in an attempt to eliminate any advantages in directivity one antenna may have had over another. The loop still exhibited at least a 3 dB advantage over the dipole and inverted vee, and in some cases was up to one S-unit better, according to the stations we worked.

The evening ended with a discussion on two-meter FM, as we analyzed the results of our tests. We all agreed that the 80-meter loop was the clear-cut winner and had a distinct edge over the dipole and the inverted vee at all distances. Since that time, one of the testers has installed his own 80-meter loop and has achieved similar results when comparing the loop and the inverted vee at his home.

The results on 75 meters prompted me to think that we should expand our testing to include all HF bands and many of the popular multiband wire antennas. Approximately five years ago, I organized several members of the State Line Radio Club of New York and New Jersey to help with the testing program. We spent several months of our spare time on this project, and in the process made hundreds of SSB contacts on all HF bands, at all times of the day and night, with stations both near and far.

We tried to eliminate the effects of QSB by having each station make several short transmissions of its callsign, repeating the process until the receiving station was certain that it could rank each antenna type against the others. Many times stations who were listening to our tests would break in with

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reports from other areas, and we would record their results as well. We felt that accepting all reports from any area would help equalize any directivity exhibited by any of the antennas in our test group.

After several weeks of testing, certain patterns began to emerge from the accumulated data. We were quite surprised to discover that some types of antennas performed better than we would have anticipated and some performed more poorly. In some cases, we repeated the tests when two or three antennas appeared to be nearly equal in performance, so that we were able to definitively rate the antennas. Some other hams who joined our test program had quads, yagis, or vertical antennas, and their results were included for comparison to the multiband wire antennas.

As the tests came to a close months later, we were excited to sift through the many reports and come up with our rankings. **Tables 2** and **3** show the results of our real-world tests. Please remember that the wire antennas and beams used in our tests were average antennas erected by average hams.

Of the multiband wire antennas, the 80-meter horizontal loop was the best all-around performer. In fact, not one of the other multiband wire antennas outperformed the loop on any band or at any distance. At times, one or another of the antennas would equal the loop in performance, but not on a consistent basis. As you can see, each antenna had its shortcomings, and some of the more widely-publicized antennas do not even come close to meeting their reputations.

Our on-the-air testing has allowed me to offer the following tips if you want to install your own horizontal loop antenna:

•A four-sided quad provides better multiband harmonic performance than a three-sided delta. Rectangles or pentagons also work well.

•The loop seems to work better when corner-fed with 75-ohm coax instead of 50-ohm coax. (Varying the feedline length may improve multiband matching.)

•A multi-turn coaxial-coil RF choke placed at the feedpoint of the antenna works well to keep RF off the shield.

•450-ohm open-wire used as a feedline for the 160-meter loop provided dramatically improved performance over coax when this antenna was used on 20 meters and higher.

•Higher is not necessarily always better, but the loop should be at least 1/8-wave above ground on the fundamental frequency.

One final test may be of interest. A fellow club member purchased and installed a new 70-foot tower and one of the better-rated linear-loaded triband beams following our initial tests. His old trap tribander on a 50-foot tower had been outperformed by my loop on several occasions, and he was looking

Antenna Type (40–50 feet above ground)	Cost	Radiation Pattern	Feed Line	Optimum Results	Tuning Requirements	Notes
Full Wave 80 m Horizontal Loop	Low	Many lobes and nulls on higher bands	Coax or open line	10–80 m; very broad-banded	T-match with balun	Needs 4 supports. Excellent low-noise antenna, including SWL.
Centerfed Zepp	Low	Varies with band	Open wire	On several bands	Balanced-wire tuner	Classic multiband antenna. Used over 60 years.
Inverted "L"	Low	Varied lobes and nulls	Coax	Only on a few bands	Wide-range tuner	Quite directional on higher bands.
Windom	Low	Varied lobes and nulls	Open wire or coax and special balun	Only on a few bands	Wide-range tuner	On some bands, open-wire portion is part of antenna.
Multiband Trap Dipole	Low to Medium	Bidirectional	Balun or coax	On several bands, when mounted high above the ground	None, if properly made	The old standard. Fair for DX.
G5RV	Low	Varies with band	450-Ω wire line to balun and coax	On resonant band	T-match	Compromise antenna, poor for DX.
2-Element Multiband Quad	Medium to High	One main lobe	Coax	On a maximum of 5 resonant bands	Built-in match at antenna	Needs tower and rotator. Height not as critical as with yagi.
Trap-Type Triband Yagi	High	One main lobe	Coax	On resonant bands; 10 m, 15 m, 20 m	Built-in match at antenna	Needs tower and rotator. Higher is better.
Half Wave Vertical	Medium	Omnidirectional	Coax	10–20 m	Built-in match at antenna	Good for limited-space applications.

***Table 3.** Results of antenna comparisons.*

for revenge! As we scouted the 20-meter phone band, we located a Tasmania (VK) station who was willing to compare our signals, and as we started testing, a local "Big Gun" asked to join the test. We agreed, thinking that his participation would provide for more interesting results. The Big Gun was definitely a Big Gun superstation. He had stacked monobanders on a 110-foot tower and a three-tube Alpha capable of 3 kW!

The first report from the VK showed that the kilowatt-fed tribander and the 80-meter loop were S-6, and the Big Gun was S-9 in Tasmania. When the Big Gun turned off his Alpha, we were all S-6! Now, who do you think got the most satisfaction from these reports? My friend with the new $1,200 tower and tribander, the Big Gun with his $10,000 antenna system, or me with my $20 horizontal loop?

You may disagree, but after 20 years of general hamming, DXing, and occasional contesting, I am extremely satisfied to have accomplished so much with such a minimal investment. My 80-meter horizontal loop antenna consistently outperforms all other simple multiband wire antennas and usually holds its own on the higher bands when compared with ordinary yagis installed at ordinary heights. If you decide to try one, you will not be disappointed!

As a final note, I would like to thank all the local and worldwide hams who have made this article possible through their patience and enthusiasm for our antenna testing project. 73

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Intro to Superhets

Part 2: From oscillators to detectors.

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This is the second part in the series on the introduction to superheterodyne receivers. The first part covered the history of the receiver's development and began a discussion of the stages within the receiver. The next stages to be discussed now begin with the oscillator and end with detectors. Part 3 will discuss some of the more popular accessory circuits used with superhet receivers.

Oscillator

The purpose of an oscillator is to provide a local signal to beat against (mix with) the incoming signal at the mixer to provide superheterodyning action. There are many different types of oscillators and they fall into basically two categories: fixed and tunable. Fixed oscillators may be crystal-controlled, synthesized PLL, or direct digital synthesized. The objective is to provide a very stable oscillator signal. And, if synthesized, it will usually be adjustable to a multiple number of discrete frequencies.

A tunable oscillator is of the type used in low-end broadcast and FM radios. The oscillator is free-running and varied in frequency by changing either the tuning capacitance or inductance. The objective of using a tunable oscillator in a modern receiver is to accommodate low cost and compactness, and perhaps to be less complicated than utilizing a synthesizer.

One of the specific requirements of the oscillator is to provide a stable signal free of distortion. This means that the oscillator waveform must be as close to a sine wave as possible. Should distortion be present in the oscillator output, the signal would create multiple mixes generating many spurious signals. The IF would be flooded with a series of spurious signals resulting in mixes which would confuse the listener, should they propagate through the receiver. In any case, the spurious signals would increase the receiver-generated noise which could mask a desired incoming signal.

IF amplifier

More and more signals are being transmitted each day as the need for communication increases. With only a given amount of frequency spectrum available, it is necessary to crowd these signals close together to make room for others. The receiver must select the desired signal and reject all others.

To do this, the IF amplifier in the receiver must have a narrow passband to allow only a narrow range of frequencies to pass. Multiple-tuned resonant circuits, ceramic and crystal filters, and mechanical filters are the methods used for narrowing the passband.

The property of a receiver to pass a narrow range of frequencies is called selectivity. The selectivity of an IF amplifier is a measure of the total response of all of the tuned circuits in the amplifier. A typical IF response curve is shown in **Fig. 1**. The broadness of the peak portion of the curve for each tuned circuit depends upon its

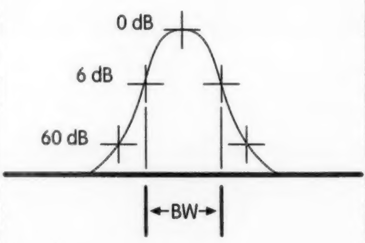

Fig. 1. IF response curve showing where bandwidth is measured at 6 dB points as a function of voltage levels.

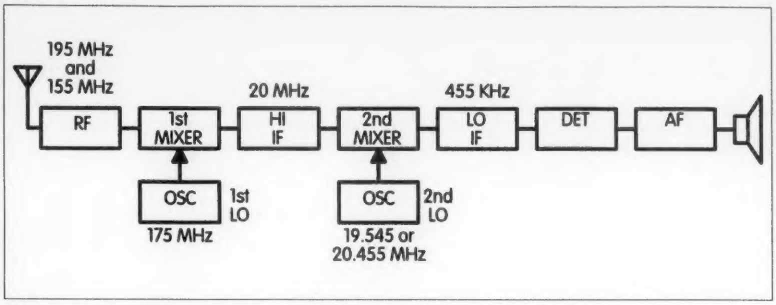

Fig. 2. Dual-conversion superheterodyne receiver showing desired and image signal inputs. Alternate second local oscillator frequencies are shown.

Q factor. In general, the response of a tuned circuit is given approximately by the relation:

$$\text{Bandwidth (kHz)} = \frac{\text{Tuned frequency (kHz)}}{\text{Q of tuned circuit}}$$

The sensitivity of an IF amplifier is determined by measuring the signal-to-noise ratio. In the past, the sensitivity was determined by comparing the signal level to noise quieting with the result indicated in decibels, but signal-to-noise ratio is more definitive as a measure of sensitivity.

For the IF amplifier to perform properly, it should have sufficient gain to amplify the weak signal output from the mixer to a level sufficiently high to drive a detector. Consider the fact that an IF theoretically could function with a gain of perhaps one, and doing so might not generate any noise that would contribute to the masking of an incoming signal.

The question arises then as to how the signal amplitude could be raised to be usable by the receiver operator. If the signal is sufficiently strong to be detectable, the increase in desired amplitude could be accomplished all in the audio amplifier, where noise generation is reasonably easy to control. Although this concept holds some promise, it is typical to have considerable signal gain in the IF amplifier because some detector circuits are very dependent upon the incoming signal level being above a threshold value for that detector to function.

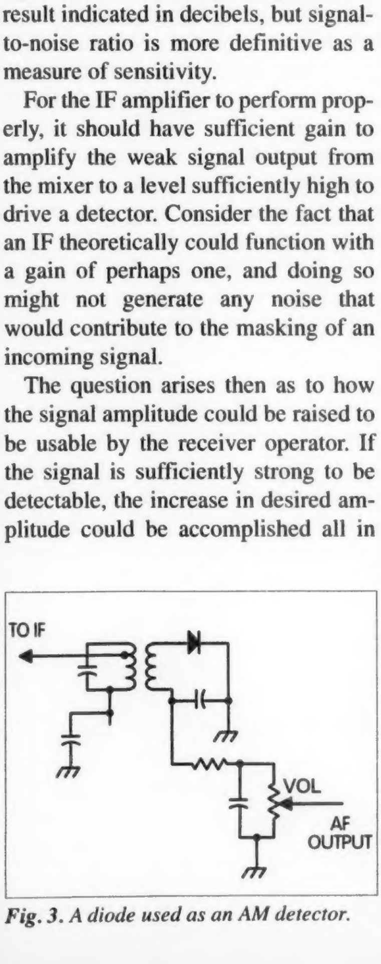

Fig. 3. A diode used as an AM detector.

Selection of the proper IF amplifier frequency is important and is the decision of the receiver designer. If the IF passband is too narrow, a tunable receiver will be difficult to tune; if too wide, the receiver may not be selective enough. There are many standard frequencies that have been used over the years for the IF, with 455 kHz and 10.7 MHz being very common. Should a low-frequency IF be selected for, say, a VHF/UHF receiver, the potential for images is very high, causing severe interference problems. By raising the IF amplifier frequency, the interference can be reduced and possibly eliminated. However, the bandwidth of the receiver will be increased and may allow adjacent channel signals to enter the receiver.

The receiver should have multiple conversions, to obtain image rejection and to achieve a narrow passband. If two conversions are utilized, the receiver is called a double conversion receiver. This is shown in **Fig. 2**. The receiver has a desired input frequency of 155 MHz and a first IF of 20 MHz. The oscillator frequency is placed above the input signal to eliminate images from aircraft at 115 MHz. With the oscillator at 175 MHz, the image would be at 195 MHz. The high frequency first IF stage places the image

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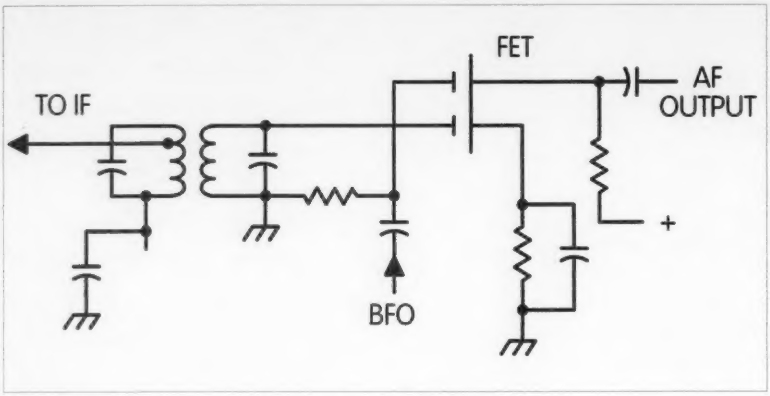

Fig. 4. *A product detector implemented with a dual-gate FET.*

40 MHz away from the desired incoming signal and essentially eliminates the image completely. Then, to obtain selectivity in the receiver, a low-frequency second IF at 455 kHz is used. The second conversion converts the 20 MHz signal to 455 kHz by beating the 20 MHz signal against a low-frequency oscillator of either 19.545 or 20.455 MHz.

The low-frequency oscillator may be placed above or below the high IF amplifier frequency. The only concern here is whether the harmonic of the low-frequency oscillator signal creates an interference problem at the receiver's input of 155 MHz. The eighth harmonic of the 19.545 MHz frequency is 156.36 MHz, which is 1.36 MHz away from the desired input at 155 MHz and little, if any, interference would occur. But if interference *should* occur, the 20.455 MHz frequency would be considered as an alternate following the same analysis.

After the high-frequency IF moves the image outside of the receiver's front end passband, the low-frequency IF is then used to narrow the passband to provide the desired selectivity.

Converting RF from one frequency to another has become the norm in receiver design, but there is a simpler design that is currently being used with success in the ham bands. The receiver is a direct conversion superhet that converts the RF directly to audio. Direct conversion eliminates the IF amplifier, but does generate a new set of problems requiring resolution. One of the major issues is having the oscillator (LO) operating essentially at the same frequency as the incoming signal. As a result, the LO output must be isolated from the incoming signal path. When used as a CW receiver, the LO doubles as the BFO.

Some nonsynthesized ham band receivers use a crystal-controlled first oscillator that is switched to achieve various bands and/or band sections. Each band/section is tuned by tuning the frequency of the second conversion oscillator. The objective of crystal-controlling the first conversion and tuning the second is to provide stability in the first converter and bandspread capability with the second.

In the past, when the receiver was to be used to receive FM signals, the last stage or two of the IF operated as an amplitude limiter to effectively remove any amplitude variations in the received signal, providing FM with a relatively noise-free performance. Limiter action was created by operating the stage at a high gain and having a low signal saturation threshold. When a signal was received, the limiter would create a DC bias relative to the strength of the incoming FM signal. The DC bias on the input would reduce the dynamic range of the stage, causing it to limit its amplitude response. In other words, the output amplitude remained fairly constant over a fairly wide range of input signal amplitude variations. Since most noise creates a voltage amplitude change, the limiter was effective in stripping the noise off the incoming signal. The limiter was required specifically when the FM detector was a Foster-Seeley discriminator, which was sensitive to both amplitude and frequency signal changes. Other types of FM detectors tend to be self-amplitude-limiting, which eliminates the requirement for having IF amplifier limiters.

However, one of the effective features of using an IF amplifier limiter is that all signals reaching an FM detector will be of equal amplitude. When the signal amplitude to the detector is a constant, the recovered audio level is then a function of the frequency deviation. For the user, this is important because all received signals from a specific service would tend to sound equally loud. Unlike FM, signals received by an AM receiver will have an audio recovery that is dependent both upon the strength of the received signal and the percentage of modulation used. Automatic gain control (AGC), originally called automatic volume control (AVC), was utilized to assist in keeping the recovered audio level at a near-constant value by attempting to control the sensitivity of the overall receiver through individual stage gain control.

Detectors

In the discussion of receivers up until now, little concern had been expressed regarding the type of modulation that exists on the received signal (carrier). Each transmitted signal has a carrier (present or suppressed) that has been modulated in order to transfer intelligence from the transmitter to the receiver. The purpose of the detector is to demodulate the received signal and recover the modulation. To gain an understanding of how the detector functions, let's discuss typical detectors for each modulation type.

AM detector

An AM detector is perhaps the simplest of all detectors, consisting simply of a diode (see **Fig. 3**). The diode operates as a half-wave rectifier, rectifying all signals that appear at the output of the IF amplifier. The detected output follows the modulation envelope of the received signal. Once the signal arrives at the detector, the carrier is no longer required and is separated from the modulation to leave just the audio. To perform this operation, an RC filter is used, usually consisting of two capacitors and a resistor. The filter is typically also used as the de-emphasis network that reshapes the recovered audio to make it sound normal. Without the de-emphasis network, the audio would sound "brilliant" with an overabundance of highs. During the transmission of AM signals, the higher audio frequencies tend to be less emphasized than the lower frequencies. As a result, it is necessary to increase the amplitude of the higher audio frequencies through pre-emphasis to make up for the loss during transmission. After filtering out the carrier, the recovered modulation is an audio voltage that has been reshaped to match the audio entering the transmitter's microphone.

Although the diode detector was most suitable for AM, it could also be used for slope detecting FM. One of the difficulties of slope detection is the loss of audio amplitude as the signal deviation approaches the bandwidth of the IF, creating distortion in the recovered audio.

Product detector

In the case of single sideband (SSB), the carrier and one set of modulation sidebands are intentionally suppressed at the transmitter, leaving only one set of sidebands to be transmitted. When the signal arrives at the receiver, the carrier must then be restored in order to demodulate the sideband properly. Restoration of the carrier is accomplished by using a local oscillator for "carrier reinsertion." All of the transmitted intelligence is carried in one set of sidebands, which permits the suppression of one set at the transmitter. In addition, no intelligence is transmitted in the carrier; therefore, suppressing the carrier and one sideband allows all of the available transmitter power to be applied to the one transmitted sideband.

Another form of amplitude detector, as shown in **Fig. 4**, is the product detector used for demodulating an SSB signal. There are many different circuit designs available for use. The name "product" comes from the fact that two incoming signals are multiplied together to form the resulting output. One of the incoming signals is the local oscillator used for carrier reinsertion, and the other is the received signal exiting the IF. The carrier reinsertion level is fixed in amplitude and, essentially, added to the incoming modulation envelope of the SSB signal. The resulting output is an audio voltage that follows the modulation envelope pattern of the transmitted signal.

There are many differing designs for a product detector, but each does essentially the same job in the demodulation process. Of concern is that the local-carrier amplitude be as high as possible in order to minimize intermodulation distortion products, yet isolation is essential in preventing the oscillator signal from feeding back into the IF.

As in the AM detector, all RF signal energy must be removed before the audio is presented to the audio amplifier. An RC filter is used for this purpose.

FM detectors

An AM detector may be used to detect FM, but the performance of the receiver would be poorer than if an FM detector were used. An FM detector is somewhat more complex than an AM detector, and there are many available. Each operates on the principle of converting a changing frequency (deviated signal) to an amplitude-changing voltage, where the method of detection may relate to an amplitude change as a function of frequency, a phase shift, or a detection of the actual frequency shift. To see how each type functions, let's examine a few of the typical detectors used over the years of receiver development.

Foster-Seeley discriminator

A Foster-Seeley discriminator as shown in **Fig. 5** was the staple of FM detectors for a long period of time. It was really a takeoff on the AM detector from the standpoint that it is sensitive to both amplitude and frequency

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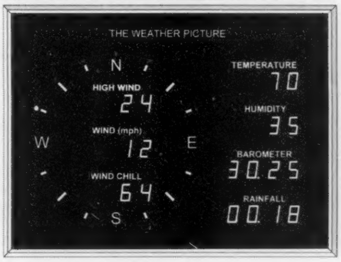

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changes. The amplitude sensitivity aspect was "cured" by preceding the detector with an IF limiter. Then the recovered audio amplitude was in direct proportion to the frequency deviation. In looking at **Fig. 5**, you can see that a coupling capacitor ties the top of the primary winding to the center tap of the secondary winding, and both windings are tuned to resonance at the intermediate frequency. As a result, the secondary winding is provided both inductive and capacitive coupling to the primary, developing an IF voltage across the secondary, which is 90 degrees out of phase with the primary. Each diode receives an equal voltage to be rectified, and the diode output differential will be zero when the carrier is centered within the receiver's passband. When the incoming signal moves (deviates) to one side or the other from the zero point, then each diode will conduct a current which is proportional to the frequency shift from zero. This results in a differential voltage produced at the detector output which is relative in magnitude to the amount of deviation. The recovered audio is usually filtered and shaped with an RC filter before the audio voltage is presented to an audio amplifier.

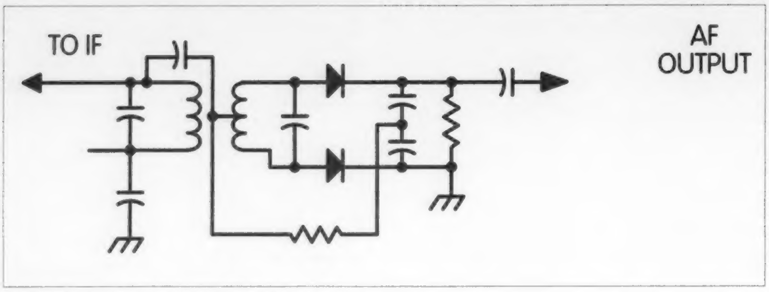

Fig. 5. *Typical Foster-Seeley FM discriminator.*

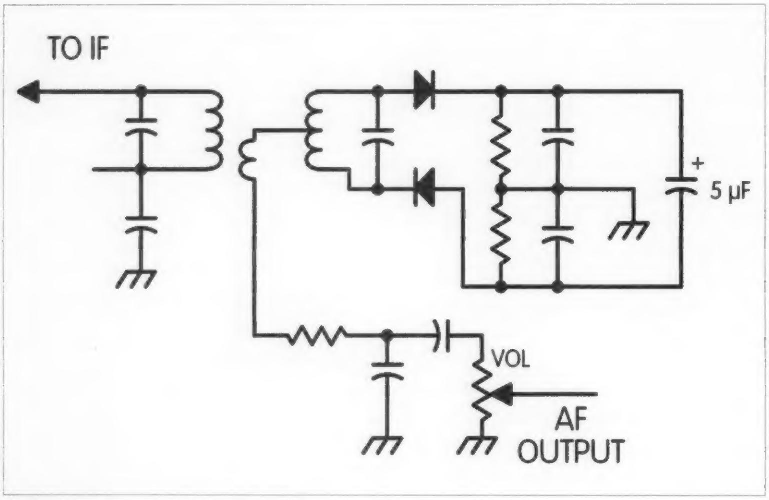

Fig. 6. *Typical ratio detector for FM demodulation.*

Ratio detector

Ratio detectors, as shown in **Fig. 6**, operate on the same principle of a 90-degree phase shift between primary and secondary windings as a Foster-Seeley discriminator. However, the voltage developed across the output circuit remains fairly constant because the diodes conduct in series, aiding, not opposing as in a discriminator. The output voltage produced across the 5 µF capacitor is proportional to the strength of the received signal, rendering the detector insensitive to noise and AM signals. The large capacitor is used to provide a long RC time constant for limiting amplitude variations. Although an IF limiter was not required ahead of the ratio detector for noise elimination, the detector was still responsive to the amplitude strength differences between received signals, meaning that one station might sound louder than another. The

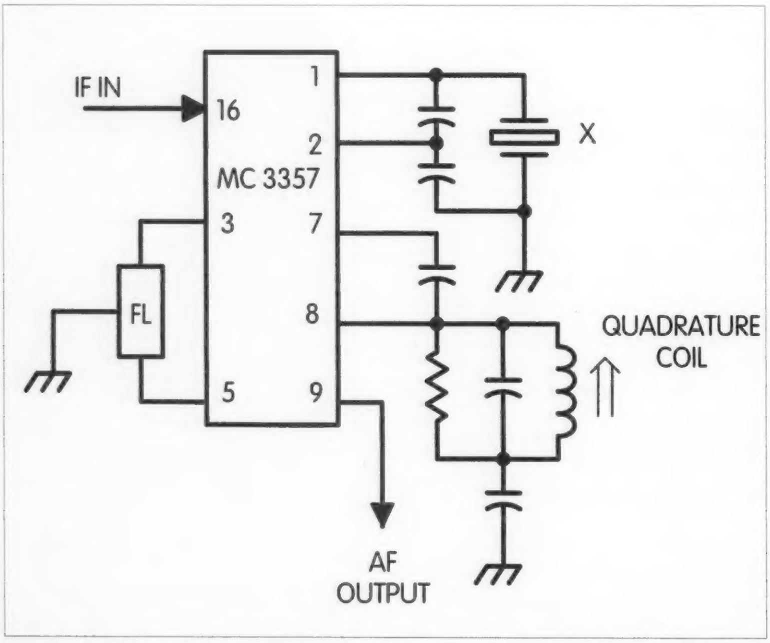

Fig. 7. *Quadrature detector for FM demodulation utilizing an MC3357. The quadrature coil operates at 90 degrees from the signal through FL.*

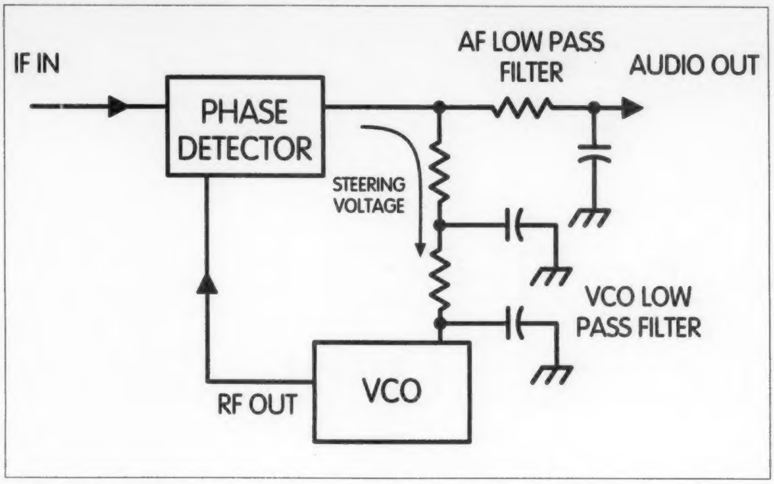

Fig. 8. PLL FM demodulator. VCO steering voltage follows the frequency deviation of the incoming signal.

use of an IF limiter "cured" that problem when the need was critical.

Audio output from the detector was taken from the center tap of the secondary winding, where the recovered audio voltage amplitude was proportional to the shift in the deviated carrier.

Quadrature detector

Quadrature detectors were originally developed for TV receivers because they were inexpensive and easy to implement. However, a special tube type was required for the circuit. Then, with the advent of solid state radios, a solid state version of the detector was developed, which is now pretty much a standard for communications radios. The most popular IC used for receiver IF and detector circuits is the MC3357, a portion of which is shown in **Fig. 7**, which incorporates the electronics portion of the quadrature detector circuit. A quadrature coil is used external to the IC as a reference signal for detecting the deviation of a received signal. In essence, when a signal is received, a portion of the signal is split off and used to excite the quadrature coil, causing it to resonate at the intermediate frequency. In a quadrature detector, a 90-degree phase shift exists between the voltage produced by the coil and the incoming signal. The two resulting voltages are compared and produce an audio voltage proportional to the signal deviation. An RC filter is used at the audio output to shape the audio being presented to the audio amplifier.

Phase locked loop detector

Phase locked loops (PLL) are used for many purposes. One of the prime ones is generating a multitude of available frequencies, each having the stability of a crystal. Using the PLL as a detector, as shown in **Fig. 8**, follows the principle of tuning the VCO to the intermediate frequency and allowing the VCO to lock to the incoming signal. A phase detector exists between the VCO and the incoming reference signal and is used to compare the phase of the two signals. The phase difference between the two input terminals is 90 degrees, and a DC output voltage will be produced which is proportional to the difference in the phase between the two signals. A long time constant is utilized at the steering voltage input to the VCO, to prevent the VCO from following the deviation of the incoming signal. What this means is that the steering voltage, while attempting to drive the VCO, will be proportional in magnitude to the amount of deviation of the incoming signal. Audio is then recovered from the steering voltage line between the phase detector and the VCO. Three of the more popular PLL detector ICs have been the NE560, NE565, and the 4046. A resistor and capacitor are used for adjusting the frequency lock range of the internal VCO.

Next time: Accessory circuits can make superhet receivers more user-friendly, as well as adaptable to many applications.

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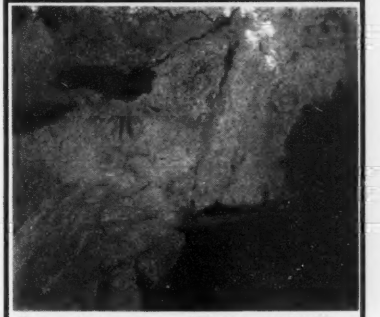

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Build the NHRC-4 Linking Repeater Controller

...And get with the program.

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The unexpected success of our earlier repeater controller project ("Build a $60 Talking Repeater Controller," *QST*, February 1997), including user feedback, prompted us to design another low-cost controller project. NHRC-2 users wanted another simple repeater controller with linking capability. We thought about their requests for a while, and then we designed this project: the NHRC-4 Linking Repeater Controller. You'll find information about kits and assembled and tested units at the end of this article.

The NHRC-4 controller will easily integrate to any repeater. It has two radio ports: primary and secondary. The primary port supports a normal full-duplex repeater, while the secondary one can be used for a remote base, a link radio, or a "slave" repeater.

The controller supports all the standard controller features: CW ID, courtesy tones, and timers for the ID; "hang" or "tail" timer; and an individual timeout timer for each port. The CW messages, timer values, and other parameters are all programmed over the air with DTMF command sequences. The controller has LED indicators for PTT and CAS for each port, and a DTMF indicator for the primary port. There are expansion connectors for both ports to support external digital delay boards, which can eliminate squelch tails and the leading edge of DTMF sequences.

Each port can have a distinct courtesy tone to indicate to repeater users which receivers are active. There are five different events that can trigger a courtesy tone, and each tone can be programmed independently. The five events are: the primary port's receiver dropping; the primary port's receiver dropping while the secondary port's receiver is active and "alert mode" is selected; the primary port's receiver dropping when the secondary port's transmitter is enabled; the secondary port's receiver dropping; and the secondary port's receiver dropping when the secondary port's transmitter is enabled.

There are four different modes for the secondary port. The secondary port can be off, where nothing is received, transmitted, or otherwise indicated from the secondary port. It can be in "alert mode," where activity on its receiver is indicated by a distinctive courtesy tone on when the primary port's receiver drops. (This mode is particularly useful in the remote-base environment to indicate channel activity without having to actually listen to the channel activity on the remote base.) The secondary port can also be in "monitor mode," where its receiver audio is transmitted over the primary port's transmitter. A unique courtesy tone indicates that the repeated signal originated from the secondary port. The fourth mode is the "transmit" mode, where the secondary port transmits the signal received on the primary port's receiver, and the primary port's transmitter repeats both the primary and secondary port's audio.

The secondary port's PTT (push-to-talk) signal can be programmed to follow the primary port's CAS (carrier-activated switch) signal, or the primary port's PTT signal. Following the CAS signal is typical for remote base and linking applications, and following the primary port's PTT signal is typical for a slave repeater.

The controller also has one digital control output. This output can be turned on or off or be pulsed by DTMF remote control, or the output can be configured to operate a transmitter fan, which will be turned on when the transmitter is turned on, and run for a programmable amount of time after the transmitter turns off.

Circuit description

The controller's circuitry is quite simple, consisting of some digital level conversion networks for the CAS and PTT interfaces, audio mixing and gating, and DTMF reception, all orchestrated by a Microchip PIC 16F84 microcontroller. The 16F84 manages all controller functions. It provides internal EEPROM to store the controller's program, as well as the user-programmable CW messages, timer values, and so forth, and RAM for the program's operating variables.

DTMF is decoded by a Tel-Tone M8870 DTMF receiver, which also supplies the 16F84 with a clock signal. A quad op amp, a voltage regulator, and a handful of discrete components round out the design.

The circuit alone would do nothing without the custom software programmed into the 16F84. The control program contains approximately 900 instructions. The software provides all the logic, and generates the timers and programmable courtesy tones for the controller.

Electrical connections

The controller uses an eight-pin, 0.100 header for all the primary radio's signals and DC power; a six-pin, 0.100 header for the secondary radio's signals; and a six-pin, 0.100 header for an external TS-32 CTCSS encoder/decoder for the primary radio. In addition, it has two four-pin, 0.100 connectors to support optional NHRC-DAD digital audio delays for both radio ports.

Each radio port requires audio and a signal present indication (CAS) from its receiver, and supplies transmit audio and PTT to its transmitter. The controller requires 13.8 VDC for power, which is provided on the primary radio's connector. (Be very careful when wiring DC power to the controller—reverse polarity will severely damage the controller.)

Receiver audio can typically be taken from the high side of the squelch control. This audio must be de-emphasized with the controller's de-emphasis circuit, which provides a -6 dB/octave slope. Optionally, audio can be taken from later in the receiver's audio chain, where it is already de-emphasized. Care must be taken that this source of audio is not subject to adjustment by the radio's volume control. If the receiver audio has not been properly de-emphasized, either in the receiver itself or on the controller board, the repeater will have a very "tinny," unnatural sound to it. The NHRC-4 repeater controller can be built with a de-emphasis circuit populated on the printed circuit board, for "flat" audio response. To install the de-emphasis filter, two 100 k resistors must be removed, and 51 k and 510 k resistors added, as well as a .0068 µF. Consult the NHRC-4 Repeater Controller (audio) schematic for modification instructions.

The receiver must provide a signal present indication (also called CAS, COR, RUS) to the controller. The controller requires an "active-high" signal here. If your radio only has "active-low" signaling available, a simple inverter can be constructed with a 2N3906 and a 4.7 k resistor. Connect the emitter of the transistor to a source of positive voltage, the collector to the controller's CAS terminal, and the base to the active-low signal through the 4.7 k resistor.

Transmitter audio can be fed directly into the microphone input of the transmitter. VR5 is the master level control for the primary radio, used to set the audio level into the transmitter. VR2 is the master level control for the secondary radio. The transmitter's deviation limiter (sometimes called IDC) should

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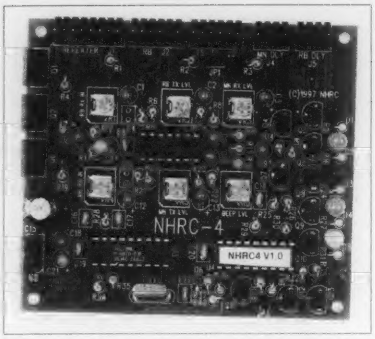

Photo A. *NHRC-4 Version 1.0 board, top view.*

be set such that the transmitter cannot overdeviate, regardless of input signal level.

One way to adjust transmitter deviation is to set the transmitter deviation limiter wide open (unlimited), adjust the controller's master output until the transmitter is slightly overdeviating, and then set the transmitter's deviation limiter to limit just below 5 kHz deviation. Then reduce the controller's master output until the transmitted audio does not sound compressed or clipped. Transmitter deviation should be adjusted with a service monitor or deviation meter.

Transmitter keying is provided by a power MOSFET (Q2/Q6) configured in an open-drain circuit. This can be used to key many transmitters directly. The MOSFET essentially provides a closure to ground for PTT. For other transmitters, the MOSFET can drive a small relay to key the radio. Although this MOSFET can handle several amps, we recommend that no more than 500 mA of current be drawn through it.

The LED status indicators

The NHRC-4 repeater controller is equipped with five status LEDs that aid in setup and troubleshooting. There are green LEDs for each radio port that indicate that the controller is getting a valid CAS (carrier-operated switch) and, if a CTCSS decoder is connected, a valid CTCSS decode signal. This LED should light when the repeater's receiver is active and, if a CTCSS decoder is present, indicate that the correct CTCSS tone is present. The yellow LED indicates that a DTMF signal is being decoded on the primary receiver. This LED should light for the entire duration that the DTMF signal is present on the primary receiver. The red LEDs indicate transmit. These LEDs will light when each transmitter is transmitting. The LEDS can be disabled to reduce the power consumption of the controller. Remove jumper JP2 to disable the LEDS.

TS-32 hookup

Connector J3 is a six-pin header that allows the easy installation of an optional Communications Specialists TS-32 for CTCSS decode and possibly encode. The TS-32 must have the JU-2 jumper cut. If you want to be able to disable the CTCSS requirement, install a switch on the HANGUP lead, or you could wire the HANGUP lead to the J1 Fan/Digital Output pin to allow remote enable/disable of the CTCSS requirement.

If you like, you can wire the TS-32's ENCODE OUT pin into your transmitter's CTCSS input to encode PL on the repeater's output. The TS-32 is normally configured with its high-pass filter in-circuit to remove received CTCSS tones. Jumper JP1 on the controller board must be removed when the TS-32 high-pass filter is used. If the TS-32 is not installed, then jumper JP1 must be installed in order for audio to pass through the controller. Consult the TS-32 INSTRUCTION SHEET for details on setting the CTCSS frequency.

Installing the audio delay

The audio delay for the primary radio simply plugs into J4. The audio delay for the secondary radio plugs into J5. If the audio delay is not installed, a jumper between pins 2 and 3 of the port's delay connector must be installed, or the controller will not pass audio.

Using the digital output

The NHRC-4 Repeater Controller has a digital output that can be used for various remote control applications or to control a fan on the repeater's transmitter. The digital output is an open-drain into a power MOSFET, which is capable of sinking quite a bit of current, but we recommend a maximum load of about 500 mA. Use a relay to drive larger loads. The open-drain output can be used to gate the HOOKSWITCH signal to a TS-32 or other CTCSS decoder. Software allows the output to be enabled, disabled, or pulsed. In fan control mode, this output will be turned on when the transmitter is turned on, and turned off a programmable amount of time after the transmitter is turned off.

Adjusting the audio levels

Preset all potentiometers to midrange. Key a radio on the primary input frequency, send some touchtones, and adjust VR4 (the primary receiver level) until DTMF decoding is reliably indicated by yellow LED D5.

The primary radio's transmit deviation is set with VR5 (the primary transmitter master level) on the controller board and the transmitter's deviation/modulation control. The key to properly adjusting these controls is to remember that the limiter in the transmitter is after VR2 but probably before the transmitter's deviation/modulation control. The transmitter's deviation/modulation control will set the actual peak deviation, and VR5 will set the level into the transmitter. You do not want excessive limiting on normal speech going through the repeater; it sounds bad and tends to "pump up" background noise. On the other hand, some limiting is desirable. An oscilloscope connected to the audio output of a receiver tuned to the transmitter's frequency will show limiting as the audio gets "flat-topped" or clipped by the limiter. Ideally, a 4.5 kHz deviation signal input to the repeater should result in a 4.5 kHz deviation output, and 5.5 kHz of input deviation should result in just under 5.0 kHz of deviation out of the repeater. A service monitor (or two), deviation meter, and/or a signal generator are necessary to do this job right.

The secondary radio's transmit deviation is set with VR2 (the secondary transmitter master level). Enable the secondary transmitter, and adjust VR2 for proper transmit deviation, similarly to what was done with VR5. Enable the secondary receiver, and adjust VR1 for reasonable deviation on the enabled transmitters when a signal is received on the secondary receiver.

Adjust VR6 (the beep level) to set the courtesy tone and CW tone level.

VR3 is used to set the receiver audio mix level, and may not need to be adjusted from midpoint.

Programming the controller

The controller's programming is protected from unauthorized access by a four-digit secret passcode. The controller is programmed by eight-digit DTMF commands that all begin with the four-digit passcode. Throughout this manual, commands will be shown as *pppp*NNNN, where *pppp* represents the passcode, and NNNN is the actual command to the controller.

In order to save space in the microprocessor memory, the NHRC-4 repeater controller represents all numbers in "hexadecimal" notation. Hexadecimal, or "hex" for short, is a base-16 number format that allows an eight-bit number to be represented in two digits. Hex numbers are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F. Converting decimal (the normal base-10 numbers that 10-fingered humans prefer) to hex is simple. Divide the decimal number by 16 to get the first hex digit (10=A, 11=B, 12=C, 13=D, 14=E, 15=F), the remainder is the second hex digit. For example, 60 decimal = 3 x 16 + 12 = 3C hex. Any decimal number from 0 to 255 may be represented in only two hex digits. Many scientific calculators can convert between these two number systems, and the Windows 95 calculator can, too, if the "scientific" view is selected. We provide a World Wide Web page that can generate all the programming data for the NHRC-4 controller quickly and easily; see [http://www.nhrc.net/nhrc4/nhrc4prog.html]. A 16-key DTMF pad has keys 0–9 and A–D, which map directly to their corresponding hex digits. Use the * key for digit E and the # key for digit F. A 16-key DTMF pad is required to program the controller. *(Note: All programming of the NHRC-4 must be transmitted to the radio attached to the primary radio port.)*

The controller will need to be initialized to allow you to set your secret passcode. Initializing the controller also resets all programmable settings to the initial defaults, including the CW ID message. It should not be necessary to initialize the controller again, unless you want to change the passcode. *The only way to change the passcode is to initialize the controller.*

To initialize the controller, remove power and install the initialize jumper (JP3). Apply power to the controller, and after a few seconds, remove the initialize jumper. The controller is now in the initialize mode. If you "kerchunk" the primary port's receiver now, it will send the default CW ID of "DE NHRC/4". Now transmit (into the primary receiver) your four-digit passcode. The controller will respond by sending "OK" in CW *once*. The controller will store the passcode and the main repeater will be enabled.

All programming is done by entering eight-digit DTMF sequences. The first four digits are the *passcode* chosen at initialization. The next two digits are an *address* or a *function code*. The last two digits are the *data* for address or function. To enter programming information, you must key your radio, enter the eight digits, then unkey. If the controller understands your sequence, it will respond with "OK" in CW. If there is an error in your sequence, but the passcode is good, the controller will respond with "NG". If the controller does not understand your command at all, it will not respond with anything other than a courtesy beep, and then only if the courtesy beep is enabled. If the controller is disabled, and an unrecognized command is entered, no response will be transmitted at all.

The NHRC-4 Repeater Controller provides several timers which control the operation of your repeater. The *Hang Timer* controls how long the repeater will continue to transmit after a received signal drops. This is often called the repeater's "tail." The tail is useful to eliminate annoying squelch crashes on users' radios. As long as a reply is transmitted before the hang timer expires, the repeater will not drop, which would cause a squelch crash in the users' radios.

The *Timeout Timer* controls the maximum duration of the retransmission of a received signal. It is more of a safety measure to protect the repeater from damage than a way to discourage long-winded users, even though it is often used that way. The NHRC-4 has a separate timeout timer for each port. The timeout timer(s) can be disabled by programming a 0 length.

Continued on page 32

DTMF Command	Address	Data	Description / Purpose
*pppp*2609	26	09	D
*pppp*2702	27	02	E
*pppp*2800	28	00	space
*pppp*2905	29	05	N
*pppp*2A3*	2A	3E	1
*pppp*2B0D	2B	0D	K
*pppp*2C09	2C	09	D
*pppp*2D0#	2D	0F	O
*pppp*2*29	2E	29	/
*pppp*2#0A	2F	0A	R
*pppp*30##	30	FF	end of message marker

Table 1*. Programming the CW ID message "DE N1KDO/R."*

Build the NHRC-4

continued from page 31

The *ID Timer* sets the maximum duration between transmissions of the repeater's ID message(s). *(Note: The NHRC-4 may transmit an ID message before the timer expires in order to avoid transmitting the ID message while a user is transmitting.)* The timer values are stored as an eight-bit value which allows a range of 0 to 255. Some of the timers require high-resolution timing of short durations, and others require lower resolution timing of longer durations. Therefore, timers' values are scaled by either 1/10, 1, or 10 seconds, depending on the application.

To program a timer value, enter the four-digit passcode, the timer address, and the timer value, scaled appropriately. For example, to program the Hang Timer for 10 seconds, enter pppp0264, where pppp is your secret passcode, 02 is the hang timer address, and 64 is the hexadecimal value for 100, which would be 10.0 seconds.

CW messages are programmed by storing CW character codes into memory addresses. Select the memory address from the "memory map" table, and select the CW character code from the "Morse Code Character Encoding" table. For example, to program the CW ID message with "DE N1KDO/R," you would use the sequences shown in **Table 1**.

The CW ID can store a message of up to 20 characters. Do not exceed 20 characters. Be sure to include the end-of-message character (FF) at the end of each message.

Controller features can be enabled with the use of the configuration flag bits (see **Table 2**). These bits are encoded in a single byte, which is programmed into the controller at address 01. Multiple flag bits can be selected by adding their hex weights.

For example, to set up a controller with an audio delay on each port, and configure the digital output for fan control, you would add 02, 04, and 10 to produce hex 16, which you would then program into address 01 in the controller with this command: pppp0131. In addition to programming the flag bits as a group using address 01, the controller supports commands to set or clear these bits individually. Command 60 is used to clear (zero) a specified configuration bit, and command 61 is used to set (one) a specified configuration bit. For example, to set (turn on) bit 3 (to suppress DTMF muting), enter the following command: pppp6103. To clear bit 3 and enable the DTMF muting, enter this command: pppp6003. Note that the bit number, not its hex weight, is used for commands 60 and 61.

The five different courtesy tones are each individually programmable, and can be unique for each event, programmed to be the same as other events, or programmed empty to be silent. The NHRC-4 will play the appropriate courtesy tones 500 milliseconds (1/2 second) after a receiver drops. The courtesy tones all consist of four 100 millisecond (1/10 second) segments. Each segment can be no tone, low tone (a "boop," about 440 hertz), or high tone (a "beep," about 880 hertz). If all four segments are programmed as no tone, the courtesy tone will be disabled. Each segment is encoded as a dibit (pair of bits) where 00 is no tone, 01 is a beep, and 11 is a boop. The four segments are ordered into a byte, starting from the LSB. If this sounds confusing to you, then use the programming generator Web page to change the courtesy tones.

The radio ports can be disabled or enabled by remote control by setting the code for the operational mode in location 00. Program location 00 to 00 to completely disable the system. A value of 01 enables the primary repeater, 02 enables alert mode for the secondary port, 03 enables monitor mode for the second port, and 04 enables transmit mode for the secondary port.

We have found that the NHRC-4 controller suited our linking needs, and we hope you will find the controller project useful, too. We want to thank our wives—Danielle, Ruth, and Sharon—for putting up with us.

Partial kits, which include the printed circuit board, a programmed PIC16F84, an M8870 DTMF decoder, and printed assembly and operating manuals, are available from us for $39 plus $5.50 shipping and handling. Assembled and tested controllers are available for $149 plus $5.50 shipping and handling. Please contact NHRC Repeater Controllers, 444 Micol Road, Pembroke NH 03275; or see our Web site at [http://www.nhrc.net]. 73

Bit	Hex Weight	Binary Value	Feature
0	01	00000001	secondary port is duplex repeater
1	02	00000010	audio delay on primary receiver
2	04	00000100	audio delay on secondary receiver
3	08	00001000	disable DTMF muting
4	10	00010000	digital output is fan control
5	20	00100000	reserved
6	40	01000000	reserved
7	80	10000000	reserved

***Table 2**. Configuration flag bits.*

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SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the December issue, we should receive it by Sept. 30. Provide a clear, concise summary of the essential details about your Special Event.

AUG 29

WESTON, WV The West Virginia State Radio Council will hold its 40th annual Hamfest and ARRL Convention August 29th at the Jackson's Mill State Conference Center in Weston, West Virginia. Flea market and tailgate spaces available. For more info contact *[wvsarc@qls.net]; or Patrick Shea N8MIN, Rt 4 Box 365F, Weston WV 26452.*

SEPT 5

CARP, ONTARIO, CANADA The Ottawa ARC (OARC), Inc., is pleased to announce its 2nd Annual Hamfest. The event will be held Saturday, Sept. 5th, 10 a.m.–1 p.m. on the Carp Agricultural Fair Grounds (at Falldown Lane) in Carp. Take Highway 417 to the Carp Road exit, north to the fairground. Tables are $10 each, plus admission; tailgate spaces $5 each, plus admission. General admission is $3. For info contact *Jim Cummings VE3XJ, (613) 446-1225; E-mail [fleamarket@oarc.net]*. Take a peek at *[http://oarc.net/fleamarket]* on the Web. The OARC Hamfest is held at the Carp Agricultural Fair Grounds at the same time as the Carp Farmer's Market, so an additional bonus is that guests can also enjoy stocking up on farm-fresh produce, and crafts from local artisans.

UNIONTOWN, PA Saturday, Sept. 5th, the Uniontown ARC will hold its 49th annual Gabfest at the club grounds located on Old Pittsburgh Rd., just north of the intersection of Rts. 51 and 119. Free parking and free tailgate space with registration. The event starts at 8 a.m. Talk-in is on 147.045(+) and 147.255(+). Table space available. For more info contact *Carl WA3HQK or Joyce KA3CUT Chuprinko, Rte. 6 Box 231-CC, Morgantown WV 26505. Tel. (304) 594-3779.*

SEPT 12

BALLSTON SPA, NY The Saratoga County R.A.C.E.S. Inc. will hold its 13th annual Hamfest on Saturday, Sept. 12th, at the Saratoga County Fairgrounds in Ballston Spa, New York, rain or shine, all under cover. Gates open at 7 a.m., with the hamfest running until 3 p.m. Admission is $4 (includes one tailgate spot and free parking). VE exams and a foxhunt will round out the program. Reserved tables $5 each, first come, first served. Reservations and prepayment welcome and encouraged. Early setup for all vendors. For reservations and further info, contact *Darlene Lake N2XQG, 84 Wilton Mobile Park, Saratoga Springs NY 12866; (518) 587-2384; packet [n2xqg@wa2umx]; or E-mail [lake@capital.net]*. Talk-in on 146.40/147.00 and 147.84/.24.

SEPT 19

WARROAD, MN The Lake of The Woods Repeater Assn. Inc. will host a hamfest at Warroad Area Community Center, 222 Virginia Ave. NE, Warroad, Minnesota. Handicapped accessible. Setup is at 10:30 a.m.; open to the public starting at 1 p.m., with a banquet and program being presented starting at 5 p.m. The banquet is limited to 100 plates; reservations are suggested. VE exams at 11 a.m., walk-ins OK. Bring original and photocopy of current license, photo ID, and a check for the fee of $6.35 (testing for Novice class is free). Talk-in on 147.090(+) and 147.00(-). Admission to the hamfest and banquet $12; hamfest only, $5. Seminars and an ARRL display will be featured. If reserved in advance, dealer and flea market tables are no charge with paid admission. Send check and table reservation to *David Landby KB0HAP, Rt. 3, Box 10, Warroad MN 56763. Tel. (218) 386-1092.* Pick up tickets and table numbers at the door. If you arrive early, please join the sponsors for a 9 a.m. breakfast at the Patch Restaurant, Highway #11 W, Warroad.

SEPT 20

CAMBRIDGE, MA A Tailgate Electronics, Computer and Amateur Radio Flea Market will be held (rain or shine) Sunday, Sept. 20th, 1998, 9 a.m.–2 p.m. at Albany and Main St., Cambridge, Massachusetts. Admission $4. Free off-street parking for 1000 buyers. Fully handicapped accessible. Tailgate room for 600 sellers. Sellers $10 per space at the gate, $9 in advance—includes one admission. Setup at 7 a.m. For space reservations or further info, call *(617) 253-3776*. Mail advance reservations before the 5th to *W1GSL, P.O. Box 397082 MIT BR, Cambridge MA 02139-7082.* Covered tailgate area available for all sellers. Talk-in on 146.52 and 449.725/444.725 pl 2A W1XM rptr. Sponsored by the MIT Radio Society and the Harvard Wireless Club.

MT. CLEMENS, MI The L'Anse Creuse ARC will host an event at L'Anse Creuse High School. Exit 236 off I-94 onto Eastbound Metro Pkwy. (16 Mile Rd.), left (N) on Crocker Blvd., right (E) onto Reimold to the last of three school buildings. Free parking. Swap 'n' shop, new and used amateur radio equipment, antique radios, electronics, computers, software, trunk sales ($5 per space), vendors. Admission $4 in advance, $5 at the door. 8 ft tables $6. Send SASE to *Richard Dzick N8MQU, Box 180072, Utica MI 48318-0072. Tel. (810) 268-4671, or E-mail [n8mqu@aol.com]*. VE exams at 9 a.m. For registration and more info call *Don Olszewski WA8IZV, (810) 294-1567*. Talk-in on 147.08(+), 146.52.

Continued on page 34

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NEWTOWN, CT The Western CT Hamfest will be held at the Edmond Town Hall, Rt. 6, 9 a.m.–2 p.m. Setup is at 7 a.m. Exit 10 on I-84. Talk-in on 147.12/.72. New equipment dealers, flea market, tailgating, and computers, will be featured. Tables $10, tailgating $6 (each includes 1 admission). Admission is $4, under 12 admitted free. Contact *Ken Weith KD1DD, P.O. Box 3441, Danbury CT 06813-3441. Tel. (203) 743-9181.*

YORK, PA The Hilltop Transmitting Society, Keystone VHF Club, and York Amateur Radio Club are joining together to sponsor a hamfest at York County Area Vocational Technical School, 500 yards off I-83, Exit 6E. Admission $5. Tailgating is $3 with paid admission. Indoor tables (advance sale) are $15 ea. Free VE exams onsite. QRP and ATV seminars will be featured at this event. Talk-in is on 146.97. Take a peek at the Web site *[http://www.yorkhamfest.org]* for more info. E-mail *[w3sst@juno.com]*, or write to *York Hamfest, P.O. Box 351, Dover PA 17315. Tel. (717) 764-8193.*

SEPT 26

DAYTONA BEACH, FL The ERARA and DBARA clubs have again joined together to sponsor a special day of bargains and fun at the Embry Riddle Aeronautical University campus, located just two miles from the heart of Daytona's shopping center. The XYL and children can shop or visit the world's most famous beach, which is just 20 minutes away. The hamfest will be on the Embry-Riddle Campus, located on Clyde Morris Blvd., just south of International Speedway (US 92). Talk-in on 147.150(+600) starting at 8:30 a.m. Admission is $5. For advance tickets send check or money order along with an SASE to *DBARA-HAMFEST, P.O. Box 9852, Daytona Beach FL 32120-9852*, before Sept. 10th. E-mail *[munseyj@worldnet.att.net]*; Web page at *[http://www.america.com/~dbara/]*. This is an indoor air-conditioned event with acres of paved parking. Handicap parking is provided. Paved tailgate area, too. VE exams, all classes. There will also be a T-hunt with a $50 cash prize.

HAMILTON TWP., NJ The Tall Cedars of Lebanon picnic grove on Sawmill Rd., in Hamilton Twp., New Jersey, is the location for a hamfest being sponsored by the Delaware Valley Radio Assn. Directions: I-95 North to I-295 South; exit 60A to I-195 East; Exit 2 to Yardville; South Broad St. to end, approx 3.7 miles; left at Yield; next right onto Sawmill Rd.; the site is 1.1 miles on the right. Open to buyers at 8 a.m. Open to sellers at 6:30 a.m. Admission $5. Non-ham spouses and children admitted free. Free parking. ARRL table. Tailgating space $10, includes one admission. Covered table space $15, includes one table and one admission, some electricity. Advance covered space reservations available. Talk-in on 146.67(-) For more info contact *Hamcomp '98, DVRA, P.O. Box 7024, West Trenton NJ 08628. Tel. (609) 882-2240;* or punch in *[www.slac.com/w2zq]* on your computer.

HORSEHEADS, NY The Amateur Radio Assn. of the Southern Tier, Inc. will present its 23rd Annual Elmira International Hamfest-Computerfest on Saturday, Sept. 26th, at the Chemung County Fairgrounds in Horseheads, New York. Talk-in will be on 147.96/.36 or 444.20 ARAST rptr. There will be dealer displays of new equipment, and a large flea market area. Breakfast and lunch will be served on the premises. Admission is $4 for advance tickets, $5 at the gate. The event will run from 6 a.m.–3 p.m., with a pancake breakfast at 6 a.m. VE exams start at 9 a.m. on the grounds; walk-ins accepted. Dealers please contact *Gary at (607) 739-0134.* For ticket inquiries, call *Dave at (607) 589-7495.* For more info about VE exams, call *John, (607) 565-4020.* RVs and trailers coming in Sat. a.m. and going out Sat. p.m., no charge. Campers in on Friday, $15 hookup, $10 no hookup. Pay at the gate Friday. Gates closed midnight Friday to 5 a.m. Sat. There is plenty of free parking for hamfest attendees, and the flea market is free (ham and electronic gear preferred). Make checks payable to *Amateur Radio Assn. of the Southern Tier, Inc. (ARAST).* Mail with an SASE to *Elmira Hamfest, c/o Dave Lewis, 465, CR 13, Van Etten NY 14889.*

SEPT 26–27

LANCASTER, NH The Moose Swappers Hamfest & Computer Fleamarket will be held at the Lancaster Fairgrounds on Route 3 just north of the center of Lancaster, New Hampshire. Features include onsite parking, over 200 hookups in the selling area, and a very large commercial vendor space at low rates or free. Miles of tailgating space at 12 feet per ticket. No tickets will be sold at the gate Friday night. Admission $9 in advance or $10 at the gate. Sunday at the gate, $5 per person. Saturday special, $20 per carload at the gate. Camping space with hookup $50 for both Friday and Saturday nights on the grounds. Gates open at 6 p.m. Friday for advanced registered ticket holders only. Saturday the gates open at 5 a.m. There is plenty of parking and camping space across from the fairgrounds for those arriving Friday without advance tickets. No waiting in line at the gate before the gates open. VE exams will be held Saturday and Sunday mornings. This hamfest was organized by *Russ N1YZE at (603) 922-5514, E-mail [cusvt@together.net], and Bob WA1DPP at (603) 838-6469, E-mail [howies@together.net].* Proceeds above operating costs go to benefit the United Way.

MILTON-FREEWATER, OR The W7DP Hamfest will be held at the Community Building, 505 Ward St., in Milton-Freewater, Oregon. Open 8 a.m.–4 p.m. Saturday, and 8:00 a.m.–10 a.m. Sunday. Setup 6 p.m.–8 p.m. Friday and 7 a.m.–8 a.m. Saturday. Admission $5 per person with under 16 years old admitted free. Tables available for $10 each. Talk-in on 147.28(+) MHz, the Blue Mountain rptr. Contact *Denise Hebel KC7ORO, (509) 527-0411; E-mail [dhebel@bmi.net].* Mail prepayments with an SASE to *W7DP, P.O. Box 321, Walla Walla WA 99362.*

SEPT 27

NEW PORT RICHEY, FL The Suncoast ARC will sponsor the 8th annual Pasco County Hamfest & Computer Show, Sunday, Sept. 27th, 9 a.m.–3:30 p.m., at the New Port Richey Recreation Center. Take US 19 to Main St. in New Port Richey, east 1.5 mile and left (north) on Van Buren. The Recreational Center is on the east side 1/2 mile north of Main. The event will be inside, and air conditioned, with outside tailgating. General admission $5, under 12 years old free. Tables $15 (includes chair, table and admission for one; electric $5 extra). 125 tables. We sell out by Sept. 1, so get your table ASAP. There will be computer dealers in attendance with a full line of computers, CDs, and software at rock-bottom prices. For more info contact *Chuck KU4EV, (813) 937-2540 or E-mail at [cfowler995@aol.com].* Talk-in on 145.35 and 147.15 rptrs.

SPRINGFIELD, OH The 1998 Independent Radio Assn. Hamfest will be held at the Clark County Fairgrounds, 1/4 mile north of I-70 Exit 59 on State Route 41. Hours are 8 a.m.–3 p.m., with vendor setup on Saturday, 6 p.m.–10 p.m., and Sunday 6 a.m.–8 a.m. Admission is $5 for adults, children 12 or younger admitted free. Free parking. The event is all indoors and handicapped accessible. Talk-in on 145.45/144.85. Outdoor sales are not permitted. For vendor or general info, leave a message at *(937) 325-3047*, or write to *Independent Radio Assn., P.O. Box 523, Springfield OH 45501.*

OCT 4

QUEENS, NY The Hall of Science ARC Hamfest will be held at the New York Hall of Science parking lot, Flushing Meadow Corona Park, 47-01 111th St., Queens, New York. Doors open for vendors to set up at 7:30 a.m., buyers admitted at 9 a.m. Free parking. Admission by donation, buyers $5, sellers $10 per space. Talk-in on 444.200 rptr. pl 136.5. For further info call nights only, *Stephen Greenbaum WB2KDG, (718) 898-5599; or E-mail [WB2KDG@bigfoot.com].*

OCT 10–11

TAMPA, FL The Egypt Temple ARA will host their 2nd annual Hamfest and Computer Show in the Unit Building located at 4050 Dana Shores Drive, Tampa, Florida. There will be 60 tables for sale at $15 each for the two-day event, 18 of which will be against the wall with standing room behind and aisle space in front. Each table will have two chairs. Admission tickets required by all except children under 10 years of age. Electricity will be available but customers must supply their own cable. Table reservations and tickets can be obtained from *J.F. Strom K9BSL, 233-34th Avenue North, St. Petersburg FL 33704-2241. Tel. (813) 822-9107.* No food or drink allowed except that being sold by Egypt Temple members.

OCT 24–25

EL PASO, TX The ham operators of West Texas, Mexico, and New Mexico are banding together to produce an all new 1998 Southwest International HamFiesta which will be held on the 24th and 25th of October. Commercial setup on Friday afternoon and evening. Hours are from 8 a.m.–5 p.m. Saturday, and 8 a.m.–2 p.m. Sunday. Indoor table space available at $10 per table (for both days) before Oct. 1st, or $12 after Oct. 1st. Please try to arrange for your table space early. Visit the Web site at *[www.hamfiesta@dzn.com]* for more details, or mail inquiries to *Hamfiesta, P.O. Box 971072, El Paso TX 79997-1072. Tel. (915) 859-5502.*

SPECIAL EVENT STATIONS

AUG 24–SEPT 7

SYRACUSE, NY The Liverpool NY Amateur Repeater Assn. Special Event Station, W2CM, will be on the air 10 a.m.–9 p.m. from the Railroad Caboose, rear of the New York State Fairgrounds, near the grandstand. Listen on 10–80 meters SSB and CW. For more info contact *Dick Page AC1M.* For an award send a large SASE to *Dick Page AC1M, 2939 Lafayette Rd., Lafayette NY 13084 USA.*

SEPT 5

NOTRE DAME, IN Notre Dame ARC will operate ND1U 1600Z–2359Z Sept. 5th, to commemorate the 100th Anniversary of the First North American Wireless Transmission. SSB: 7.250 and 14.250. CW: 7.035 and 14.035. To obtain a commemorative QSL, send an SASE to *Notre Dame Amateur Radio Club, 226 COBA, University of Notre Dame, Notre Dame IN 46556 USA.*

UNIONTOWN, PA The Uniontown PA ARC (W3PIE) will operate the club station on 147.045–3.95 00:00–03:00 and 147.045–7.25–14.3 12:00–18:00 to commemorate the 60th Anniversary of the founding of UARC. For QSL, submit SASE for a certificate to *UARC Inc., 465B Old Pittsburgh Rd., Uniontown PA 15401 USA.*

SEPT 6

PANAMA, THE REPUBLIC OF PANAMA The Radio Club de Panama will celebrate its 27th Anniversary with an HF Contest. The contest will be on the 15, 20 and 40 meter bands, single operator phone only, and will operate 00:01 UTC–24:00 UTC. Contacts between all radio hams, worldwide, are valid. For more details, E-mail *[hp1cdw@supremepty.com] or [suman@supremepty.com]. By packet, [HP1BYS@HP1CDW.PANCTY.PAN.CEAM] or [HP1BSL@HP1BSL.PANCTY.PA.CA]. Fax HP1BYS at (507) 260-9020, or HP1ECA at (507) 261-7277.* Logs must be stamped with a mailing date not later than Nov. 30th, 1998. Send to *Radio Club of Panama, Contest, P.O. Box 10745, Panama #4, Republic of Panama.*

THOMSON, IL The Palisades ARC and 90 West DX Assn. will operate W9BPT, Sunday Sept. 6th, 1700Z–2100Z, to celebrate Thomson Melon Days. Operation will be on the lower portion of the General 40 and 20 meter bands. For a certificate, send QSL and a 9" x 12" SASE to *Bob Plumley K9IEG, 1123 West Main St., Thomson IL 61285 USA.*

SEPT 11

MORRISONVILLE, NY The CVARC of Morrisonville, New York, will operate W2UXC to commemorate the US victory over the British in the Battle of Plattsburgh, Sept. 11, 1814, during the War of 1812. Operation will be Sept 12th and 13th, 1300Z–1800Z on 7.260 MHz and 14.260 MHz. For a QSL, send an SASE to *CVARC, P.O. Box 313, Morrisonville NY 12962 USA.*

SEPT 12–13

VERVIERS, BELGIUM The G.D.V. "Gang de Verviers" of Verviers, Belgium, will again operate ON4USA, 1100 UTC–1700 UTC, Sept. 12–13. The operation will originate from the Henri-Chapelle Cemetery, Belgium, and all radio operators are encouraged to participate. Station ON4USA was formed in 1988 by Mr. Christian Keldenich in gratitude for their freedom, which was gained more than 50 years ago. The station continues to operate on a yearly basis and many of the participating hams are bilingual, so language will not be a major problem. This event is conducted to honor the memory of those who gave their lives between 1939 and 1945 for the freedom of Europe, and to celebrate the liberation of the area around Verviers, Aubel, Welkenraedt, Hombourg and Henri-Chapelle, Sept. 9–12, 1944. CW—7.040, 14.040, and 21.040. SSB—14.225, 21.275, and 28.475.

SEPT 14–19

ATLANTIC CITY, NJ Southern Counties ARA will operate K2BR Sept. 14th at 10 a.m. (1400 UTC)–Sept. 19th at 11 p.m. (Sept. 20, 0300 UTC) from the Miss America Pageant in Atlantic City, New Jersey. Atlantic City is located on Absecon Island, IOTA NA111. Suggested frequencies in MHz for 10, 15, 20 and 40 meters: Phone—28.325, 21.325, 14.250, 7.250. CW—28.065, 21.090, 14.090, 7.090. QSL with a #10 SASE to *SCARA, P.O. Box 121, Linwood NJ 08221 USA.*

SEPT 19–20

HONOLULU, HI The Razorback Radio Club, K5HOG, is sponsoring the 1998 Air Force Aniversary QSO Party and is trying to reach as many Air Force veterans and members as they can. The purpose of this annual event is to gather on the air as many active and former members of the Air Force as possible for a weekend of fellowship in remembrance of all those who served. For rules please E-mail *[k5hog@aol.com] or [k5xs@compuserve.com]*, or write to *The Razorback Radio Club, 604 Julian Avenue, Honolulu HI 96818 USA.* Remember to send a business-size SASE.

SEPT 27–28

WANAQUE, NJ The Classic Radio Exchange (CX) is a contest celebrating the older commercial and home-brew equipment that was the pride of our ham shacks and bands just a few short decades ago. The object is to encourage restoration, operation and enjoyment of this older equipment. A "Classic" radio is at least 10 years old (age figured from first year of manufacture), but is *not* required to participate in the Classic Exchange. You may use anything in the contest, although new gear is a distinct scoring liability. The Classic Exchange will run from 1900 UTC September 27th–0400 UTC September 28th. Exchange your name, RST, QTH, receiver and transmitter type (home-brew send final amp tube or transistor), and other interesting conversation. Suggested frequencies are CW—3.545, 7.045, 14.045, 21.135, 28.180. Novice/Tech Plus—3.695, 7.120, 21.135, 28.180. Phone—3.880, 7.290, 14.280, 21.380, 28.320. 7.045 and 3.545 will probably be the most popular CX frequencies. For details regarding scoring, etc., contact *Howard Holden WB2AWQ at (973) 839-6086 after 6 p.m. Eastern Time, or [holden@uscom.com].* Send logs, comments, anecdotes, and pictures to *Allan Stephens, 106 Bobolink Dr., Richmond KY 40475.* Include two-stamp SASE for the next CX Newsletter and announcement of next CX. E-mail reports may be sent to Al N5AIT at *[modsteph@acs.eku.edu].*

Radio Bookshop

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ABOVE & BEYOND

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
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[clhough@pacbell.net]

VHF to microwave: how to repair old beam antennas

What started out as a winter storm here in San Diego became a severe path of destruction to my amateur-related activities and antenna system. High winds associated with the storm snapped my antenna guy wires and toppled my antenna. That was the start of all the fuss to reconstruct what had been my modest antenna system for VHF.

Evaluating the initial damage was a little hard, as the mast collapse (because of the snapped guy wire) could have been prevented by some simple maintenance. I had apparently left the system in the air for too long, without providing some care and upgrading or replacement of worn parts.

Time had made me complacent in the maintenance of my antenna system. I had not given any attention to a problem which had been waiting to happen for some time. In hindsight, we all should take time to give our systems some attention, to prevent having to replace antennas in a similar fashion.

The main culprit in my failure was the guy wires I had used. Through time they had become weak from stretching and just plain age. A simple bend showed that the material had become less malleable than new material. That should have been a great clue but it went unnoticed. All the signs were observed when the antennas were lying on top of my roof—after the system's key guy wire had broken in the high wind.

At least the roof wasn't damaged when the system came down that stormy evening. Nothing was done at the time, because we determined that no further damage could be done as long as the antennas were resting firmly on top of my roof that Friday evening. Saturday morning would tell the full tale.

I am describing this adventure in reconstruction to show the efforts I went through in an attempt to be cost-effective in making the repairs to the old existing antennas, twisted as they were. First, the careful job of removing the pile of antennas and cable and getting down to business.

On first evaluation, the two-meter and six-meter beam antennas took the worst of the storm's fury. Actually, the six-meter beam boom stopped the entire structure from becoming a tangled mass of scrap aluminum because the long boom end hit the roof and stopped the remaining antennas from becoming an intertwined mess of metal.

All was not well, as the toppling over was done in an 80-or-so mph high wind gust. It just twisted the mast after the guy snapped.

When the antennas came to rest on the end of the six-meter boom there must have been quite a shock to all of their basic structures. The gamma match of the six-meter beam shattered into a number of pieces, as did several elements of the six- and two-meter beam antennas. The RG-58 coax feeding one antenna parted, but the RG-8 (RG-213) coax held together and was at full strain holding the antenna, which was now bent over on the roof. In a way, it became part of the guy system when it went over.

Reconstruction of the system started with cutting the RG-8 coax and getting rid of old cables that were in the way. They had been in the air for many years and showed signs of age on the outer jacket. Most bolts holding the antennas were rusted beyond use and, while some came off with a little oil and elbow grease, quite a few had to be twisted off until they broke. First lesson: Spend the extra cash and use stainless or galvanized hardware on your antenna. They will not rust like common cad-plated nuts and bolts. You will thank me when you have to work on your antenna in a less hostile environment.

Removal of the beam antennas was next, placing what was left of the two- and 3/4-meter yagi antennas on the roof, off of the mast.

The last main structure to be removed was the six-meter beam. The original mast structure was removed and replaced with a new mast for the day when the antennas would go back up. Now the quandary was whether to purchase new antennas or repair the old. Taking stock, I determined that I could purchase new aluminum tubing for the six- and two-meter beam elements and (galvanized) hardware to reattach them for about $12.

The trick to pull off was how to reconstruct the gamma match of both the two- and six-meter feeds. The original gamma match systems were constructed with some sort of plastic and two sections of aluminum tubing forming a capacitor of sorts for the feed. See **Fig. 1.** How to repair this gamma match for these two bands remained to be solved. Would it be better to purchase new antennas or repair the existing? I examined the coax cable and the answer became very clear.

The coax cable was years past due for replacement. I confirmed this by testing the loss of a 50-foot section of RG-213 that had been up for a lot of years. I made a test on a new piece of RG-213 and found that the loss of the old piece was about 1.5 dB greater, compared foot for foot. The old cable had to be replaced. Purchasing new cable would be expensive. I checked the loss tables and found that Belden 9913 might be the best from the cost-to-low-loss standpoint. Expensive, but well worth it.

At two meters, the loss of Belden 9913 was one half the loss of brand new RG-213 (RG-8 quality coax). The 9913 specs at 1.5 dB and the 213 at 3 dB at 150 MHz. At 450 MHz, the Belden 9913 really shines, as its loss is 2.6 dB versus 6 dB for RG-8 types. This is a no-brainer decision—purchase the Belden 9913. Because the 9913 is a hard line type of coax, mating it to a gamma match requires that it be brought out to terminal lugs to bolt to the gamma match sections.

The #12 solid conductor of the 9913 cable was a slight problem because it has a spiral-wrapped internal construction that provides low loss but also allows water to enter at the coax end if not properly sealed. I solved this problem by crimping on my bolt connectors and then sealing the end of the open coax inner section with a small dab of RTV. I then overwrapped the center section and braid with good quality electrical tape, making many twists, figure-eights, and crossed-over tape sections to add additional protection from the weather.

Someone suggested the I apply a layer of varnish or plastic spray to cover the tape. On the advice of Kerry N6IZW, we tried some plastic sprinkler pipe glue and overcoated the tape with the plastic cement. This seemed to be best, as it really made what seemed to me to be a bond with the electrical tape and the jacket of the 9913 coax cable. This looked to me to be the best method of sealing the Belden 9913. Additionally, when I mounted the cable on the gamma match I positioned the cable on top and ran the crimp-on connections on down, forming a sort of drip loop preventing moisture from easily entering the coax cable. See **Fig. 2.**

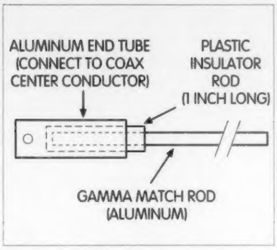

Fig. 1. Basic yagi gamma matching design typical of most commercial designs using plastic matching capacitor.

Now that my main expenditure was going for new Belden 9913 coax to replace my old lossy cable, the idea of a couple of new $150 beam antennas for two and six meters would be scrapped and the old antennas repaired. With $12 allocated for replacement element parts, the problem now remaining was how to repair the gamma matching scheme on the existing beam antennas.

Looking through various antenna handbooks and other literature, I found a simple rule stating that the gamma capacitor should be about 170 pF at 14 MHz and then scaled proportionally for other frequencies. Some simple math meant that at double the frequency, the capacitor value would be halved (28 MHz = 85 pF, 56 MHz = 42 pF, making a two-meter capacitor somewhere in the 10 pF range).

I reconstructed my six-meter gamma match by soldering a 37 pF glass piston capacitor onto short sections of brass tubing that fit over the piston capacitor and would fit over the old aluminum gamma match adjustment arm. The end by the connection to the insulator and center of the coax attachment was flattened and drilled to accept a #8 stainless bolt. The other end of the capacitor brass extension tube was slipped over the gamma arm and drilled to be secured with a 4-40 stainless bolt and nut. This attached the brass and aluminum rod firmly together, making a good electrical connection. With max capacitance at 37 pF, the brass sleeves were then overtaped and coated with plastic cement. See **Fig. 3.**

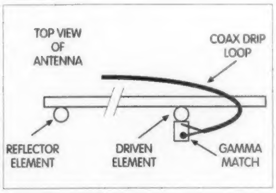

Fig. 2. Drip loop allowing rain to roll off the coax end termination by having the open end sealed and pointing down so it will not collect moisture.

This worked amazingly well, but it soon became evident that the construction was not sturdy enough for the application. The glass piston capacitor and associated rebuilt gamma arm worked very well and was easy to adjust to resonance on the six-meter beam. However, this arrangement was not as good as I thought because I cracked three glass piston capacitors before I gave up on the idea.

In actuality everything worked well, but the glass piston capacitor I used was not sturdy enough. Looking through my junk box, I found several doorknob-type high voltage ceramic capacitors in the 25 and 100 pF range. These are the ones that have for the center connection a brass 6-32 screw mounting shaft.

I tried to insert the capacitors into the brass tubing I used with the earlier piston capacitors, and had to file off the edges. Then I soldered the capacitor onto the brass tubing sections and confirmed that while the value of capacitance was a little low, this worked quite well. The hammer test with a screwdriver proved the assembly to be quite rugged (see **Fig. 4**).

Because the assembly used a gamma capacitor of 25 pF, the gamma matching arm had to be set at maximum to bring the section into resonance at 50 MHz for a great SWR of 1:1 or quite near it. As the test was made on the ground, there were, I am sure, stray effects showing up—but it worked well.

Just as with the glass piston capacitor, 37 to 40 pF would be the ideal capacitance desired for the ceramic high voltage capacitor as well. Junk boxes being what they are, I don't believe you or I will find a 40 pF capacitor. I had to settle on a 50 pF one and use it on the final gamma matching arm I constructed for the six-meter beam. The total cost of reconstruction for the gamma match was 50 cents and about five hours of elbow grease.

Oh, I forgot: There was that pint of gas to travel to K6DS's QTH to pick up the 50 pF ceramic capacitor that I used. I put the 50 pF unit on the antenna, confirmed a greater adjustment range over frequency, and then left it on for a final match when the antenna is up on the mast in the air.

For all these tests, I have attributed the ease with which I was able to make them to my MFJ-259 antenna analyzer SWR meter. Makes the evaluation and adjustment of antennas in the 2 to 150 MHz range quite easy.

Well, as you suspect, all the coax cables are cut to length and crimp connected in place, overwrapped, and sealed with connectors on the appropriate ends. What else remains to be done? In my case, it's mostly metalwork, making gusset plates to mount the boom to the two-inch mast section.

Here comes the hard part. I had to settle for less than I'd planned, as I could not find galvanized two-inch muffler U-bolts with back plates to fasten securely to the mast. I had to compromise with (untested) standard muffler clamps. These arrived as black steel and I am not sure how they will stand up to the weather.

I manufactured my mounting plates from four muffler clamps to secure the beam antennas to the two-inch main mast. It resulted in a very sturdy mounting arrangement, and was constructed out of scrap aluminum old panel sections that came out of the old junk box. I picked up the muffler clamps at a muffler repair shop. They came with the round-to-flat adapter clamp plate so necessary for securing the round tube of the boom and mast sections tightly.

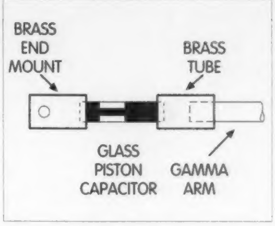

Fig. 3. The first attempt at constructing the gamma match section with a glass piston capacitor soldered to small sections of brass tubing for connections to the mounting insulator and gamma aluminum rod.

The muffler-type clamps are probably available from some hardware source, but I was unable to locate them and settled for the muffler shop clamps. The cost was minimal for the clamps: one dollar for the two-inch ones, and less for smaller clamps. Quite reasonable. I lubed mine with a little grease and slipped an SMA coax protector cover over the bolt ends to protect them from rusting. Can't have everything, but you can prepare for the future.

I hope you have gotten some ideas on antenna reconstruction from my sad tale of the destruction that occurred on that Friday evening when things went "bump in the night." 73, Chuck WB6IGP.

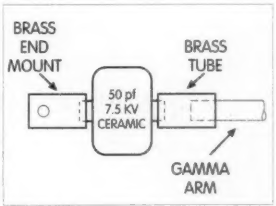

Fig. 4. Final gamma match capacitor construction using a 50 pF ceramic high voltage capacitor attached to brass tubing. Near end swaged for nut and bolt attachment and the other end inserted into the original aluminum gamma match arm. Attached with a 4-40 bolt through both brass and aluminum rod.

NEVER SAY DIE

continued from page 5

who as the Hudson Division director was secretly controlling the ARRL. He was abetted by Bill Eitel W6EI, the head of Eitel-McCullough (the tube manufacturer) and his lackey Bill Orr W6SAI.

By publishing hundreds of repeater and two-meter FM articles in *73*, plus starting a magazine (*The Repeater Bulletin*) devoted to repeaters, publishing one book after another on the subject, and organizing repeater conferences around the country, we helped repeaters emerge as the most active aspect of the hobby. It was our repeater developments that made it possible for Motorola to launch the cellular telephone industry.

It was my success in helping to change the world just a tad with repeaters that got me to see if I could do it again when the first microcomputer was announced in 1975. In addition to starting the first magazines in this new field, I also organized the first industry standards conference. I picked Kansas City for the conference because it was equally far for all of the companies to travel. That's how the Kansas City Standard for data storage came about.

Yes, you can help change the world, possibly for the better. I helped with cell phones, personal computers and in several ways with compact discs. And I'm just a guy up here in New Hampshire. I'm a guy who takes advantage of serendipity instead of ignoring it.

It was serendipity that got me to be one of the founders and the first secretary of American Mensa. Two of the other founders never did anything further and the third moved to Switzerland and dropped out. And I did that even though I was up to here in starting *73 Magazine* at the time, as well as being president of the Porsche Club and deeply involved with the Hudson Division ARRL Convention.

The year before had been busy for me, with a ham tour of Scandinavia in the spring, an around-the-world flight operating on 20 meters and stopping at around 26 countries during the summer, and representing the US as a delegate to the International Telecommunications Conference in Geneva in the fall. These were all exciting, but didn't contribute much to moving the world ahead — though many of the things I learned on the trip formed the basis for my later influence on the development of Jordan.

Serendipity (the gods? angels?) will offer you opportunities, too. Grab them.

Your Influence

I've written about this many times, but you've just pooh-poohed it. You *can* make things happen. A recent Art Bell guest explained how anyone (including you) can cause clouds to reshape themselves. He said to pick a calm day with a few light clouds and then concentrate on one particular cloud, willing a hole to open in it. When the hole does open you're going to get a whiff of a whole new world of understanding dawning for you. You *can* influence matter. And people. And the future. You are not a prisoner in the slave gang of life with God calling all the shots. You *can* help make your luck. You can also, just by believing it, make your own bad luck. If you are a negative person, you are going to continually have negative experiences. *You* are causing them.

I try to reach out to those willing to think in my editorials and books, but I know I'm up against thoroughly ingrained brainwashing from your parents, teachers, friends, and the media, so even tiny successes are a wonder. Can I get the ball rolling by getting a few readers to think? Hoping they (you) will, in turn, pass along my message?

Yes, you can influence a cloud. Yes, you can communicate with animals and plants. Yes, your cells are in communication with the whole of your body. Yes, there is a God, but there's no evidence that He is a vengeful God, or that what you say or think about Him will in any way change His love. Those are human problems.

Read, learn, and stop being screwed by people and organizations who want to take advantage of your ignorance and gullibility.

Yes, college is necessary if you've decided you want to be a teacher or to work for a large company all your life — or to work for the government. But for most entrepreneurs it's a ghastly waste of time and money.

Coda

Yeah, stop bitching about my being a broken record. I'll shut up when you start getting hamfest committees to put me on the program and you're busy hugging me for my part in changing your life. You can also keep me too busy with interviews on radio talk shows if you tell 'em about me.

Emergencies

A note from Robert Jerome N8PTI of Saginaw, Michigan, says that in his recruiting for the Amateur Radio Emergency Service (ARES) he's getting only Tech licensees volunteering. The older hams tell him, "We did it, let someone else do the public service."

Sigh.

It's lucky I'm not in Robert's place. I'd say: Look here, you fat old curmudgeons, name one thing that you are doing to pay back the public for the billions of dollars of radio frequencies which you're being permitted to use. You are no longer providing any trained operators or technicians in case of war. You haven't for years done anything to advance the state of the communications art. You can't even fix your own equipment when it breaks, much less design or build anything. A few of you still can use the Morse Code, which is about as useful for military or commercial communications today as a knowledge of smoke signals. Its *only* use today is as entertainment.

The Japanese Meltdown

A prophet should have a more immediate medium than a monthly magazine. I guess I'll have to pay more attention to the Internet. Anyway, I'm writing this in late June as I'm reading about how the Japanese yen is being supported by us. Well, I don't have to go very far out on a limb to predict that the Japanese banking industry is heading for a total collapse. And that's going to take the rest of Asia along with it.

The basic problem is simple. As has happened here in America, the Japanese banks bought each other out, ending up with a handful of huge banks. In the process the real estate loans on property (which was enormously overvalued) left the banks with very little in the way of assets. Any demand for cash would collapse the whole system.

Worse, over a trillion dollars of the bank loans were made to *Yakuza*-owned (the Japanese version of the Mafia) and mostly worthless companies. These are loans which will never be repaid.

To date, the Japanese government, not having any solution to the situation, has been mostly wringing its hands. No attempts have been made to eliminate the basic problems. So any money we or the IMF throws into the mess is money lost. If any of it does get to a bank, the *Yakuza* will grab it first.

Then There Are Our Banks

I'll bet you haven't noticed that the American banking system has, just in the last few years, consolidated to maybe five or six huge banks. And do you know that they're all foreign-owned? That reminds me of what I found when I got involved with the music industry. I discovered that 96% of all record sales in America were being made by just six music megacorporations, five of which were foreign-owned. And they were making damned sure that no independent music company

Number 39 on your Feedback card

THE DIGITAL PORT

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Carson City NV 89703
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All modems aren't created equal. You may recall the serial modem I described in the February column that worked so well for RTTY and SSTV—plus it is so reasonable to build. There are others out there, many are similar, and they all function and are fun to use. This month I want to tell you about a modem that isn't just another plain-Jane black box, but is a top-drawer piece of equipment replete with bells and whistles I didn't know existed.

I received the Timewave DSP-599zx with the new DSP-RTTY program and was nearly overwhelmed with the claims made in the accompanying manual. A whole new world of ham digital electronics must have been stuffed in a very small box.

The proper order of approach for me was first to learn what the DSP-599zx hardware could do on its own before using the internal modem. There have been reviews of this unit previously, so I will merely give you a few of my first impressions.

Upon opening the manual, you find a section that explains how to see it work for SSB and CW with just a few quick cable hookups. I did that and determined that the device worked. Those two modes weren't what I was after, but the unit definitely cleaned up signals without adding ringing noises as my old standby, the Autek QF-1A, is prone to do.

The next step was to see how this worked in conjunction with the AEA PK232. The difference is fantastic. The hookup was simple enough, using the information supplied with manuals from Timewave, ICOM for the IC-735, and AEA for the PK232.

The excitement began

Timewave knows their stuff when they recommend plugging external stereo speakers into the filtered output of their unit. I have been certain for years that you and I come equipped with a marvelous listening system that we can train to pick out a signal from a jumble of noises and then mentally tune to. We can even set our attention on one CW signal and copy it with real discipline. However, that works only somewhat for SSB and we can only do this with CW for a few minutes before our minds rebel. And all this discipline is to no avail with RTTY, PACTOR, SSTV, or any other such mode because the ordinary demodulating system can't train itself to listen to just one set of tones while rejecting the others.

That was true before DSP came to rest in the shack. The difference is so remarkable that you simply have to be there to believe it. Since the order of the day is going to be a discussion on RTTY, I will tell my experiences using the DSP-599zx in front of the PK232.

The PK232 has long been a standard of the industry and I have had this one for most of that era. Since the entry of DSP into ham radio technology, I had wondered just how well it would enhance copy. I had listened to a few signals on radios with

Continued on page 40

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could survive for long by spending about $100 million a year to bribe the music directors of radio stations to *not* play independent music.

I also found that 98% of the performers on these major labels were never making a nickel on royalties. This was confirmed in a *Forbes* article, so this isn't just rhetoric.

We used to have a bunch of banks around this part of New Hampshire. Now everywhere I look it's either a Granite Bank or a Bank of New Hampshire.

Y2K News

Maybe you read about the emergency control center in Cheyenne Mountain testing their computer system to make sure it was Y2K compliant. They reset their computers to December 31, 1999, and waited for the clock to roll over to January 1, 2000. Instead, everything just shut down.

The Russians have just recently been made aware of the Y2K problem. After a survey they've decided there's nothing they really can do about it. They don't have the programmers or the money to tackle the problem, so they've opted to just wait and see what happens.

One (me, for instance) wonders what's going to happen when the control systems preventing nuclear missile firing shut down all over their country.

Is it really possible that our major corporations, and our government, have been ignoring the problems that their computers are going to experience come January 1, 2000? Is it possible, as Gary North is predicting, that our telephone system, power companies, and most government operations will suddenly stop that Saturday morning? This is so completely beyond belief that the natural reaction is to pooh-pooh the whole idea.

To get a better understanding of what's involved, visit [www.garynorth.com] and start reading the postings. There are some from skeptics, but you'll note that these birds don't have much in the way of credentials. When you start reading the postings from the systems analysts and programmers who're in the trenches, it's "Oh, my God!" If I were trying to get the real impact across I'd make that about *six* exclamation points, not one. But I'm conservative, so you do some homework and start blowing your mind at what you learn.

The people at my bank say it's Y2K compliant. But they admit that they are tied in with their whole banking system, which isn't, and that the whole system could crash as a result.

Without money, power, gasoline, and food deliveries, telephones, and so on, your company will have to close down until the whole infrastructure is up and running again. And that could take weeks, months, or even years.

Maybe you're still in Y2K denial, a comfortable area which is densely populated with our managerial elite. Then, how about a little more homework. Try investing $20 in Yourdon's *Time Bomb 2000* (Prentice-Hall). Ed explains why our hospitals, police, water, electricity, mail, schools, and so on are likely to stop, possibly for weeks to months.

So what's the problem? It's that many computer systems have been programmed to read year 00 as 1900 instead of 2000. We're talking about thousands of mainframe systems, where most of the original programmers are retired or dead, the languages and compilers they used are

Continued on page 60

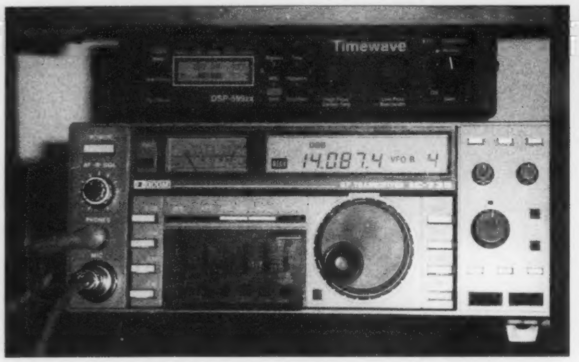


Photo A. *The DSP-599zx has a relatively small footprint, about 7-1/2 inches wide. I thought at first the size of the buttons would make operation difficult, but there is plenty of room for me to get to side-by-side buttons to press them simultaneously. The display window keeps you abreast of the many functions and is quite readable from across the operating table.*

DSP technology on display at ham stores and wasn't overly impressed.

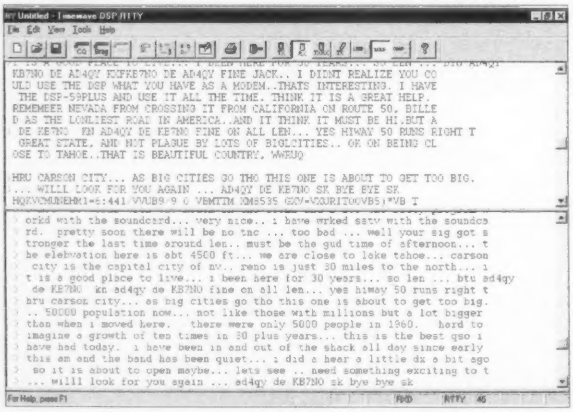
Enter the DSP-599zx

No ringing. Just tune, adjust/tweak, and copy. This means that here is a piece of equipment that can make the digital modes really come to life when a lot of the signals I hear are barely moving the S-meter.

When tuning RTTY through the PK232, the tuning indicator on the 599zx is the first area on which to focus. When the indicator shows about equal deflection in both directions, the copy may appear on the monitor, but sometimes there are garbage strings. Then, by following the instructions to tweak the knobs on the front panel, the copy, as if by magic, becomes solid.

The 599zx has another feature that makes a huge difference. After demodulating the signal, you can put it in the remodulate mode and the signal is fed to the PK232 as pure as if the transmitter were across town.

Several novel effects are noticeable. The first one is manifested at the tuning bars on the PK232: They suddenly display only mark and space bars, and there are no hash bars in between! The second is that if the signal isn't absolutely clean, I could tweak the receiver tuning just slightly and everything would clear up and the copy would be as close to 100% as conditions would allow. As mentioned above, this tweaking could be accomplished on the front panel of the 599zx. And remember, this was with most signals at about S-0.



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KB7NO DE AD4QY KXFKB7NO DE AD4QY FINE JACK.. I DIDNT REALIZE YOU CO
ULD USE THE DSP WHAT YOU HAVE AS A MODEM..THATS INTERESTING. I HAVE
 THE DSP-59PLUS AND USE IT ALL THE TIME. THINK IT IS A GREAT HELP.
REMEMEER NEVADA FROM CROSSING IT FROM CALIFORNIA ON ROUTE 50, BILLE
D AS THE LONLIEST ROAD IN AMERICA..AND IT THINK IT MUST BE HI.BUT A
 DE KE7NO  KN AD4QY DE KB7NO FINE ON ALL LEN... YES HIWAY 50 RUNS RIGHT T
 GREAT STATE, AND NOT PLAGUE BY LOTS OF BIGLCITIES.. OK ON BEING CL
OSE TO TAHOE..THAT IS BEAUTIFUL COUNTRY. WWRUQ

HRU CARSON CITY... AS BIG CITIES GO THO THIS ONE IS ABOUT TO GET TOO BIG.
... WILLL LOOK FOR YOU AGAIN ... AD4QY DE KB7NO SK BYE BYE SK
HQKVCMUNEHM1=6:441 VVUB9 9 0 VBMTIM XM8535 GXV=VXURITOOVB5)*VB T
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 orkd with the soundcard... very nice.. i have wrked sstv with the soundca
 rd.  pretty soon there will be no tnc ... too bad ... well your sig got s
 tronger the last time around len.. must be the gud time of afternoon... t
 he elebvation here is abt 4500 ft... we are close to lake tahoe... carson
  city is the capital city of nv.. reno is just 30 miles to the north... i
 t is a good place to live... i been here for 30 years... so len ... btu ad4qy
  de KE7NO  kn ad4qy de KB7NO fine on all len... yes hiway 50 runs right t
 hru carson city... as big cities go tho this one is about to get too big.
 .. 50000 population now... not like those with millions but a lot bigger
 than when i moved here.   there were only 5000 people in 1960.   hard to
 imagine a growth of ten times in 30 plus years... this is the best qso i
 have had today.  i have been in and out of the shack all day since early
 this am and the band has been quiet... i did a hear a little dx a bit ago
  so it is about to open maybe... lets see .. need something exciting to t
 ... willl look for you again ... ad4qy de KB7NO sk bye bye sk
```

Fig. 1. *This was a portion of a QSO using DSP-RTTY, in which we were discussing the use of various methods of handling RTTY. The split screen is obvious. Timewave gives an example with a third screen to allow simultaneous monitoring of the DX-Cluster, but my computer does not have enough serial ports at this time.*

A third effect tells the real story. Ham bands just don't sound right to me unless I can hear most of the spectrum up and down from the signal I am tuning to. Therefore, for a time I left the speaker connected to the audio before the DSP filter when listening to digital modes. The 599zx has a speaker output that I plugged the headphones into (this is the recommended connection for the station speaker, and by the end of a few days I grew into that mode). The difference is dramatic; the signal is there, the noise is gone.

Of course, when working sideband it is necessary to use the filtered output or there is no effect. For creatures such as I, Timewave built in a quick bypass feature: Toggle the bypass button and the filter is in or out of there in an instant. You can have it both ways.

A very convincing advantage came to light as I was working Ulf DL5AXX with RTTY. His signal was quite readable, but he complained that mine was a bit rough to copy and he pulled it out by using his DSP. The story unfolded within a minute as I was sending the last round of the QSO. My amplifier bit the dust, which meant that my signal hadn't been nearly where it should have been, but DSP had rescued the contact. I signed with Ulf *sans* the amplifier and was under the distinct impression he was still copying me due to the technology at his end. If the contact had lasted one more time around, I would have asked what DSP unit he used.

Great software

Now, you can take full advantage of the unit without the need for a TNC between it and your computer. The new DSP-RTTY program does that and the features are designed for the serious RTTY operator.

This program installs easily into Windows 95™, Windows 98™, or Windows NT™. Installation is intuitive and takes care of itself, as we have learned to expect from good Windows programs. Follow the simple instructions and you will be up and running in minutes. The documentation is straightforward.

The biggest help is within the online help files. You will find how to edit the macros and create your own for nearly effortless communication. Instructions are included for such things as inserting the station's call you are about to work, which is started by pressing [Alt-K] for the pop-up window. Then, when you wish to insert the call into text, you merely use [Ctrl-K] and it appears. You do the same to insert your own call into the text with [Ctrl-C].

It becomes quite natural after a few times around and leaves time to think ahead instead of search the screen for the other station's call. I find I can cut down on the repetitive chores and focus instead on the operator's name and interests. Keeps my head from hurting needlessly.

The fact is, when you take full advantage of the program, you can rattle along with intelligible exchanges more quickly than if you had a self-correcting link with PACTOR or AMTOR. This is not to say you will not miss a few characters now and then, but there is no delay in waiting for the transmissions to become perfect.

Simple hookup

Connect the serial cable from the computer to the 599zx (supplied), a cable from the speaker output to the back of the 599zx (roll your own), add the radio to 599zx cable that comes with the DIN connector at one end to fit the 599zx, and you are nearly there. Connect 12 VDC and

Photo B. *Hookup is made simple. The DSP-RTTY software comes packaged with a 9-pin to 9-pin serial cable and an interface cable with the DIN connector wired on the DSP-599zx end and instructions to wire the other end to connect to your radio. You need a 12 volt (cable not shown) and speaker output cable. The cable to the left is from the speaker output of the 599 to a set of headphones.*

plug-in speakers or headphones to complete the job. (See **Photo B.**) The radio connection is the only challenge, but the 599zx can be made to work with any modern transceiver. Timewave has a tech line and they have heard just about all the common connection questions.

The program is intuitive and intended for the serious RTTY *aficionado*. One of the features that struck me right away is a button to click to send what I had typed ahead, and then return automatically when the message was sent to receive. And the send-receive transition is immediate. Some Windows programs seem to spend several seconds during the changeover.

There are almost countless possibilities for macros to send everything from your call to automatic CQ, to a brag tape, to contest exchanges that you can modify to suit your needs and taste.

The remodulate mode that works with a TNC does not work with the modem, but it is not necessary; the demodulated signal is about as pure as it can get when it gets to the program in the computer.

I had at this point broken myself of the habit of listening to the "raw" signals coming in from the radio. There is a bypass that allows for that exercise, and you will be amazed at the noise on the band sometimes when you bypass the 599zx. Also, I found that if I allowed the regular speaker output to run the station speaker, the audio available for the 599zx was noticeably reduced.

Press the bypass button during marginal conditions and copy will usually turn to unreadable garble or completely disappear from the monitor. Plus, you will notice that if there is a lot of interference on frequency, the signal will disappear into the depths of the "hash" when you press the bypass button; then, miraculously, when you toggle the button out of the bypass mode, the signal emerges audibly and the received copy displays on the screen. This happens almost instantly.

One evening, the local atmospheric noise was exceptionally bad and I found the true value of tuning with the filter on and doing its job. The noise was registering an S-5 on the meter and there were no audible signals. But there were signals. All that was necessary was to tune slowly through the RTTY window and signals would show themselves. With a little careful tweaking, I copied nearly every one of them. And they were weak signals, believe me. Without the noise, I doubt if there would have been any movement of the S-meter.

All in all, I am totally enamored with the DSP-599zx and the DSP-RTTY software. The DSP-599zx by itself helps all modes, but their modem program is the showstopper. As I spoke to John Douglas at Timewave, I mentioned the fact that they would have a hard time prying them out of my fingers. The

Current Web Addresses

Source for:	Web address (URL)
HF serial modem plans + software	http://www.accessone.com/~tmayhan/index.htm
PCFlexnet communications free programs	http://d10td.afthd.th-darmstadt.de/~flexnet/index.html
Tom Sailer's info on PCFlexnet	http://www.ife.ee.ethz.ch/~sailer/pcf/
SV2AGW free Win95 programs	http://www.forthnet.gr/sv2agw/
BayCom – German site	http://www.baycom.de/
Pasokon SSTV programs & hardware	http://www.ultranet.com/~sstv/lite.html
Winpack shareware for Windows	http://www.duckles.demon.co.uk/ham/wp.htm
Baycom 1.5 and Manual.zip in English	http://www.cs.wvu.edu/~acm/gopher/Software/baycom/
Tucson Amateur Packet Radio—where packet started—new modes on the way	http://www.tapr.org
TNC to radio wiring help	http://prairie.lakes.com/~medcalf/ztx/wire/
ChromaPIX & W95SSTV	http://www.siliconpixels.com/
Timewave DSP & former AEA prod	http://www.timewave.com
VHF packet serial modem kit	http://www.ldgelectronics.com

Table 1. *Current Web addresses. All of the above were cut and pasted directly from the Web page to avoid the inevitable errors when copying. If you encounter a problem with a European address, the network is often at fault. Try again later.*

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
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Niles IL 60714-3108
[dmiller14@juno.com]

Roger and Ron Block of PolyPhaser Corporation have put together a well-written series of tips and suggestions on how we can effectively protect our ham radio stations from the effects of a lightning strike. The series began in the January 1998 "Ham To Ham" column and Part 9 follows:

Lightning protection—what your mother never told you!

Longevity

After a ground system has been installed, inevitably it begins to age. Copper and other metals are attacked by acids while aluminum is attacked by bases. In addition, other chemicals may be present in the soil which can cause decreased effectiveness of the grounding materials.

Maintenance testing is important. While some ground systems will last 30 years, others are not nearly as durable. The proper way to test the effectiveness of a grounding system is to use an earth resistance meter, which will provide a "fall of potential" type of test.

Safety hint: Use caution when connecting a ground system to the existing electrical utility ground rod. Depending on ground conductivity, harmonic and other currents could flow, causing a spark when connected.

Having VSWR trouble or telephone interference with your multiband HF vertical? When you have a ground-mounted multiband HF vertical antenna, the ground radials normally connect to the coax cable's shield. Since the equipment end of the coax line will be at some random length (which can approach a quarter wave or some multiple thereof) from the antenna, RF energy, using the coax's shield as a radial, will show up as high VSWR on that band or bands. It can be corrected by decoupling the coax with a "poor man's balun." Even though a ground-mounted quarter-wave vertical is not a balanced antenna (and shouldn't need a balun), the technique works because the coil also acts as an RF choke to RF currents traveling on the cable's outside shield. RF currents on the inner surface of the shield are a necessary part of the circuit path, but not on the outside surface. You can easily form an RF choke by making an eight-turn coil, six inches in diameter, right in your coax feedline. Give it a try if you're experiencing the problem mentioned. If your coax goes up from ground level to a first or second story level, the radiated near-field energy from the antenna will also give "higher VSWR-like" indications. This can be fixed by adding another coax coil (in the same manner as above), but this time near the transmitter. This "choke" will provide a high impedance to the captured RF on the coax's outside shield surface and reflect it back. If a decoupling coil is present near the antenna feed (described above), the RF will continue to bounce back and forth until it's either radiated or lost due to resistance, with no effect on your measured VSWR. Additionally, if you don't eliminate the RF riding on the outside of the coax cable, it can make the equipment cabinet high (hot) with RF voltage. Since the cabinet is connected to the power safety ground, if you're not using the recommended single point grounding technique, the safety ground will carry the RF to the telephone company-installed protector. Chances are, the utility safety power ground is poor or is highly inductive. The RF will then likely fire the telephone company's protector, causing interference to your phone. It can even cross-couple to other lines in the same cable run to the central office.

Providing a good earth ground for both lightning and RF, interconnecting the utility safety ground into your overall ground system, using a single-point ground configuration (as we've discussed in previous installments) and installing a low-inductance interconnect path between the single-point and the external ground system will do a lot toward eliminating these RFI problems (in addition to protecting you from lightning surge currents).

Moderator's note: In another section of this series we were warned about coils in the coax cable feedlines acting as air-wound pickup coils for the magnetic field generated by a lightning stroke. That danger still exists (as previously detailed), so the suggestions given here are not completely without their inherent drawbacks. One solution may be to enclose the coils of coax just mentioned inside a magnetically shielded metal container that's properly bonded to the single-point ground at the outdoor end and to the single-point ground at the station end.

Do you know why steel ground rods are copperplated? If you answered "to increase conductivity," you'd better read on. The base metal, steel, is more conductive than the best soil or even salt water. The real reason is for corrosion resistance. Copper, silver, mercury and gold all have high resistance to corrosion. Those metals that are never found free in nature, like aluminum and magnesium, are easily corroded. Noble metals (like copper) become the cathode when joined together with less noble metals in the presence of an electrolyte (ionic water). Less noble metals become the sacrificial anode and corrode away.

Graphite (though not technically a metal) is even more noble than silver and certainly much nobler than copper. Therefore, if a graphite backfill material is used as a ground enhancer to surround copper, the copper will be sacrificial to the graphite and will dissolve away into the ground.

The following affect the amount and speed of corrosion both above and below the soil:

Water. The presence of water, mixed with contaminants, is the basis of galvanic corrosion. Pure rain water is slightly acidic (pH 5.5 to 6.0). It picks up carbon dioxide as it falls, which creates carbonic acid. It can start attacking some metals, even copper, without being in a junction. The ions etched from the copper go into solution in the rain water. As this rain

---

hardware sells for $369.95 and there is a version that fits into the Yaesu SP-5/SP-6 speaker with nearly identical features available for $349.95. The program sells for $69.95 and I understand there are plans to further enhance it with logging features. At this time, the screen activity can be directed to files on disk for later reference. Timewave does have a Web site. (See **Table 1**.)

If you have questions or comments about this column, please E-mail me at [jheller@sierra.net] and/or CompuServe [72130,1352]. I will gladly share what I know or find a resource for you. On packet, I see my current PBBS address is shutting down. If your packet mail comes back or is not answered, that is the reason. I am searching for a new address. For now, 73, Jack KB7NO.

water drips on galvanized tower sections, it will cause the zinc to combine and wash off. This leaves the bare steel to oxidize away.

Oxygen. This is the main corrosion accelerator. Rain water also picks up oxygen as it falls through the atmosphere; water is an excellent carrier of oxygen.

Temperature. Generally, the higher the temperature, the faster the chemical reaction.

Texture of the metal(s). Glass-smooth surfaces are less likely to corrode than rough finishes.

Hydrogen Sulfide. A gaseous product of exhaust emissions, it combines with rain water, creating acid rain.

Chlorine. Tap water can have an acidic effect on underground materials.

Inert gases. Helium displaces oxygen and reduces the corrosive effect.

Alkaline. Although some alkalis tend to increase the rate of carbon dioxide absorption from the air (which creates corrosive carbonate solutions), slight amounts of alkalinity can reduce corrosion rates.

Salts. Sodium chloride (found just about everywhere) increases the soil conductivity and also increases the corrosion process (in nearly the same proportion to its concentration). Other naturally-occurring salts or man-added salts will do about the same. Only sodium carbonate or phosphate and potassium ferrocyanide form a protective film that prevents further corrosion.

Microorganisms. Both bacteria and fungi can cause metal to deteriorate. Some will give off acids in trapped water, or, when they die, will decompose into acids.

There are several types of corrosion. Listed below are the common names given for descriptive purposes:

Uniform Etch. A direct chemical attack from salts, urine and acids. If allowed to continue, a polished surface will dull and then take on a rough or frosted appearance.

Pitting. Tiny pinholes from localized chemical or galvanic attack.

Intergranular. Usually galvanic, this is a selective attack along the grain boundaries of an alloy metal. We refer to this as "de-alloying." Typical corrosion-resistant alloys can break down when corrosion actually works on the individual components of the alloy.

Exfoliation. Found on extruded metals, the corrosion occurs just below the metal surface and causes a blister to form. This appears where the extruding dyes have forced the crystal structure of the metal to change direction.

Galvanic. This is the classic two-dissimilar-metal-connection, with a water electrolyte bridge, and is the most basic of corrosion problems.

Concentration Cell. As the amount of oxygen reaching the electrolyte varies, the rate of corrosion will vary accordingly. Highly concentrated areas of oxygen will have high levels of corrosion.

Stress. More corrosion will occur where high tensile stress is applied. This occurs where metal is bent or where rivets have been driven in, and in metals that have been cold-worked (bent back and forth several times). Copper is easily cold-worked and should be annealed (stress relieved by heating). Stress corrosion appears as a crack running parallel to the metal's grain.

Fatigue. Another form of stress corrosion where pits are defined along the grain. Additional stress begins to concentrate around them and cracking occurs at the bottom of the pits.

Filiform. Thread-like filament corrosion occurring under painted surfaces where water and oxygen have penetrated and form a corrosion concentration cell.

That's Roger and Ron's presentation for this month. The "Ham To Ham" column will continue this series on protecting your ham station from the destructive effects of a lightning strike with Part 10, the final installment, coming up next month.

Making the cut!

From Stephen Reynolds NØPOU: "Used, nonworking camcorders are popping up more and more at garage sales, flea markets and even hamfests these days. Many people simply replace an inoperative camcorder with a newer one, rather than pay the high price of having an older model fixed. Since most camcorders come with a carrying case, battery and battery charger, even if you'd rather not get involved in trying to fix the camcorder, these accessories can often be very useful in and of themselves.

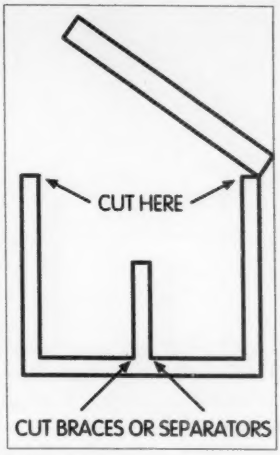

***Fig. 1.** Dissecting a camcorder case.*

"The carrying cases are usually pretty sturdy, so a few minutes modifying the case for other purposes can be well worth the effort. If needed, the inside of the typical camcorder case can usually be cut away, leaving the outer shell for storage of ham gear for QRP operation, Field Day, vacation or other needs. The best method

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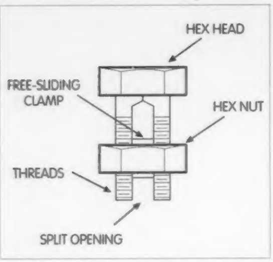

***Fig. 2.** Anatomy of a split bolt.*

that I've found is to use a sharp utility knife to cut just under the inside lip (as shown in **Fig. 1**). On some cases, you'll also have to cut out some braces or separators, but they do normally all come out. The gutted case can then be lined with foam rubber, and custom separators can be added as needed to accommodate your own particular ham equipment.

"Need an auxiliary battery for your hamfest HT or perhaps as a backup to a QRP rig? Some of the older camcorders have fairly husky rechargeable battery packs as a part of their package. It's often possible to remove the camcorder's battery holder (the holder that the battery clips onto) from the body of the camcorder without a great deal of work. Some simply snap onto the body, others are held in place with several small screws, but a few may require some surgery in the form of a sharp utility knife and/or a fine-toothed hacksaw to part them from their hosts! Be very careful if you encountered the latter; it may not be worth the risk of personal injury and/or damage to the holder itself. Providing that the battery and its charger are in good working order (you tried that first, of course), you should now have a combination that will serve you for some time."

A "close-in" antenna for 40

From Bruce Cameron WA4UZM: "While the most basic amateur antenna remains the simple dipole, if you construct it strictly from 300-ohm ribbon lead (as often recommended in the books), it probably won't even come close to matching your modern, 50-ohm-only solid state transceiver's input/output impedance. For years, I've successfully center-fed a 40-meter dipole, consisting of about 64 feet of wire, with either RG-8 or RG-58 50-ohm cable, and with the flat-top of the antenna only eight to 10 feet above the ground. The low overall height gives a very high radiation angle, which is ideal for close-in work or statewide nets. The mismatch is tolerable (being about 40 ohms instead of 50) and the tuning is fairly straightforward.

"Careful tuning is a must for best results, but it doesn't take all that much effort or equipment. The easiest way is with one of the newer, self-excited RF bridges, coupled with lots of patience. I've found the best way is to start with 66 feet of wire, looped through egg insulators at each end, doubled back on itself, and temporarily secured with split bolts. Try to keep both halves of the dipole as close to the same length (symmetrical) as you can, for best results. You should be able to end up with an SWR of 1.5 to 1 or less (though you'll probably notice an SWR change between wet and dry ground). My present antenna is simply made of split zip-cord; I've heard some people say that insulated wire is less prone to noise."

*Moderator's note: If you're not familiar with the split bolts that Bruce refers to in his tip, stop by your local hardware store or electrical supply shop and show them the drawing in **Fig. 2**. A split bolt, as the name implies, is basically a brass bolt, with a slit down the center and a free-sliding clamp and nut on one end. The main antenna wire, and its looped-back end, occupy the space inside the slit, and the free-sliding clamp piece and nut are snugged up to hold the combination firmly in place. If you need a little more or a little less wire during your antenna tune-up trials, just loosen the nut on the split bolt and adjust the length of wire as needed. A split bolt on each wire end can also serve as the permanent method of securing the assembly once it has been successfully tuned. Additionally, I think that Bruce's reference to insulated wire being less prone to noise may stem from the fact that when bare stranded copper wire is exposed to the elements, the individual copper strands tend to partially self-insulate from each other as copper corrosion develops over time. As the antenna wire moves, due to the wind, or expansion and contraction with temperature changes, small amounts of noise voltage may be generated by the partially-insulated individual strands rubbing together. Weathertight, insulated, stranded conductors and bare solid wire don't exhibit this tendency. Also keep in mind that any insulated antenna wire will add apparent length to the dipole's size, so the exact end-result length may be somewhat different from what the formulas and antenna book tables show as the normal "finished length" of a dipole for a particular frequency. The finished antenna's height above ground (and surrounding objects in the near field) will also affect the antenna's naturally resonant frequency. Finally, plain copper wire (even if covered with plastic insulation) will tend to stretch more than copper-coated steel antenna wire, so some adjustment with time and weather conditions may be necessary (significant sag might occur with a heavy winter icing, for instance).*

Murphy's Corollary: Everything, except getting into hot water, always takes longer than expected.

That's all for this month. Thanks for tuning in the "Ham To Ham" column, and please keep this column in mind when you have something that you'd like to contribute. Some of the best information that we can apply to our day-to-day ham radio operation comes from others who've encountered similar situations ... and found workable solutions. As "Ham To Ham" concludes its third year on the pages of *73* with this issue, many thanks, as always, to our loyal contributors, including:

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If you're missing any past columns, you can probably find them at *73's* "Ham To Ham" column home page (with special thanks to Mark Bohnhoff WB9UOM), on the World Wide Web, at [http://www.rrsta.com/hth].

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of *73*, and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or *73* for any equipment damage or malfunction resulting from information supplied in this column.

Please send any ideas that you would like to see included in this column to the address at top. We will make every attempt to respond to all legitimate ideas in a timely manner, but please send any specific questions, on any particular tip, to the originator of the idea, not to this column's moderator nor to *73*.

Number 45 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
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The Dayton Youth Forum on Saturday, May 16, 1998 at Hamvention© was a fun place to be this year. I am always impressed with the number of bright, articulate youngsters across the country who are involved in exciting aspects of ham radio. It's a pleasure to interview these young people during the year and present them at a national forum where they are able to showcase their skills and share their enthusiasm with others.

My first speaker was John Pituch W2MBY, who is 11 years old, from Livingston, New Jersey. John has been licensed since August, 1997. His dad, W2MY, first got him interested in the hobby by inviting him to come along to various Field Day and other public service events.

John feels it is very important to have a young ham be part of any presentation about ham radio that an adult is giving. That way the prospective young hams in the audience can say, "Hey, I can do that."

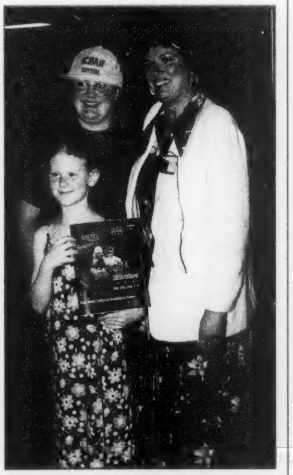

Photo A. Crystal Hart KC0AJF, 12, Rebecca Rich KB0VVT, 8 years old, and Carole Perry at the 1998 Dayton Youth Forum. Photo by Dave Rich KG0US.

He's a member of the ARRL, QRP Amateur Radio Club International, FISTS, New Jersey QRP Club, Internet QRP Club, and 10-10 International. His favorite ham activities are HF CW, contesting, DX, ragchewing, and public service.

John had a wonderful slide presentation which showed lots of fun activities for young people.

The second speaker was Crystal Hart KC0AJF, 12 years old, from Boulder, Colorado (**Photo A**). Crystal has been a member of BARC Jr. for one year. This group is the youth auxiliary club of the Boulder Amateur Radio Club. Ellie and Rip Van Winkle, who are the "heart and soul" of this young adult club, have organized efforts for the past several years to send wonderful, articulate children as representatives to appear at my youth forum in Dayton. Elmers such as the Van Winkles are a gift to amateur radio.

Crystal shared with the audience that she has her General license along with 20-word code credit towards her Extra ticket. She had a wonderful slide presentation which highlighted many of her favorite activities in ham radio. Crystal explained "home-brew" to the newcomers in the audience. She enjoys building her own equipment. We saw slides of a J-pole antenna and some other equipment she built, soldered, and debugged by herself.

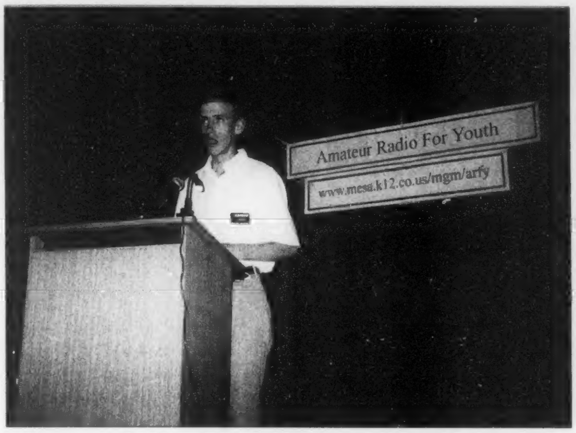

Photo B. Blair Harness KB0ROM, 17, Tech-plus. Photo by Carole Perry.

Crystal has started a ham radio club in her middle school and has encouraged her teacher to sponsor it.

Every once in awhile I invite an adult to speak at this forum. John Crovelli W2GD, from Bridgewater, New Jersey, gave a talk on contesting and how it can be a great experience for kids. He got interested in ham radio at age 10 and since has become well known as a DXer and a contester. He feels that children can learn so much from this part of the hobby that they should be encouraged to participate in it.

John pointed out that through contesting children can learn about propagation, radio wave phenomena, and basic electronics. He also had a slide presentation of impressive highlights of the fun and achievements he has had over the years.

Richard Stubbs KC5NSZ is the customer service manager for MFJ. He and Martin Ju, the founder of MFJ, have made appearances to donate equipment at my youth forums for the past six years. They are extremely supportive of educational efforts to encourage children to get into the hobby. It's always a pleasure to have their participation, and of course the youngsters in the audience look forward to the drawing for prizes. This year MFJ donated a six-meter rig as a prize. The happy recipients keep coming back to the youth forum every year to reminisce with the audience. It's a lot of fun.

The next young lady is a real showstopper. Eight-year-old

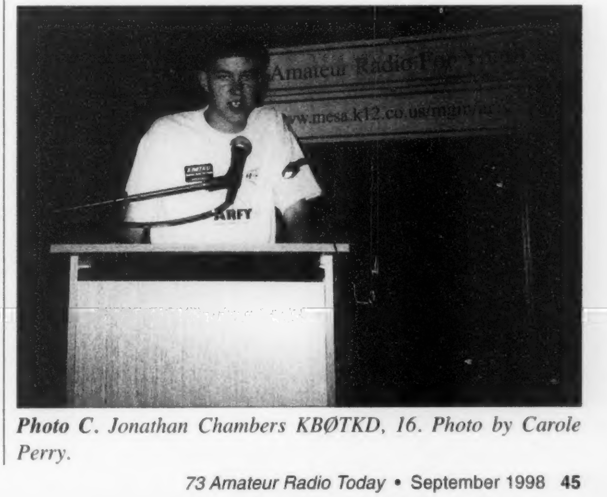

Photo C. Jonathan Chambers KB0TKD, 16. Photo by Carole Perry.

Number 46 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister W5ACM
14714 Knights Way Drive
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Last month we asked a hard question: Does Phase 3D have a ride? Since then it has been learned that the answer is NO. AMSAT's newest satellite will not be launched on the third test flight (AR503) of the *Ariane 5* rocket. On June 15th, Phase 3D Project Leader and AMSAT-DL President Karl Meinzer DJ4ZC was informed by the European Space Agency (ESA) program board that Phase 3D would not be included on the manifest for the *Ariane 503*.

In an unexpected turn of events, Arianespace, the privately held commercial company that provides launchers for ESA, announced that they would cover the remaining development cost of *Ariane 503* in return for complete control of the lower payload space on the flight, the spot Phase 3D would have had. The $35 to $40 million that Arianespace brings to the ESA program board is far more than AMSAT groups around the world can match. Cash talks.

The purchase of the launch space on AR503 is considered by some to be a conflict of interests for Arianespace. In addition to being the launch provider, they are now also a customer. Originally it was thought that they would send a dummy satellite, just a dead-weight mass, on the flight to expedite the launch timetable. It is possible that they may adjust the launch data sufficiently to allow time for repairs to a communications satellite that was damaged in the lab. With a successful launch of a functioning satellite in the place of a dummy, they could then market the communications channel of the satellite, and become not only a launch customer, but also a communications provider and broker.

Photo A. *Andy W5ACM experiments with a Grundig Yacht Boy 400 receiver and a two-meter HT using a 5/8-wave whip antenna for RS-12 Mode "A" satellite operation.*

Adversity and opportunity

When Phase 3D was not ready for the *Ariane 502* launch last year, the ESA declared their contract with AMSAT to be void. They ignored the fact that the flight requirements had changed. The changes caused serious time and money problems for AMSAT, which was hard at work mechanically strengthening Phase 3D for the anticipated rough ride of an *Ariane 5* booster. In January

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Rebecca Rich KB0VVT is an Extra class license holder from Missouri who comes from a ham family. When her dad, David KG0US, designed a computer program for her mom Barbara KG0UT, Rebecca started to play with it. She found she could answer many of the questions. At the age of six, Rebecca earned her Technician license and told her parents she enjoyed it so much she wanted to go higher. After she got her Advanced license, the pressure was on for the whole family to study for their Extras.

They all took the test in March, 1997, and all of them passed. Rebecca is currently the youngest Extra class in the United States. Mom gave a follow-up presentation to Rebecca's talk at the forum. She outlined the study guides they followed, allotting times for code practice and sections of the theory. Both parents stressed that when working with children, it's important to limit the study time, make sure they can read and understand the test words, and most importantly, that they have fun!

The next speaker was another youngster from BARC Jr., Blair Harness KB0ROM. Blair (**Photo B**) is 17 years old and has a Tech-plus license. He has been with the group for four years, during which time he has held office as vice president, secretary, and treasurer. Blair has been the Field Day chairman for BARC Jr. for the past three years. He had a wonderful slide presentation of BARC Jr. at various Field Day activities. He stressed how important the role of Elmers is for a club of young people. They truly appreciate the tremendous efforts of these instructors and Elmers at events like Field Day, where there is so much to do.

After Blair spoke, I had the Elmers who had accompanied the BARC Jr. speakers to Dayton stand up for deserved recognition. Never underestimate the importance of strong adult support when working with children.

This was the year of great contributions to the youth forum from the state of Colorado. Bill Nesbitt KG0ZI brought the most wonderful group of presenters from Grand Junction, Colorado. They belong to ARFY—Amateur Radio For Youth. This began as a group of adults who encouraged youngsters to get involved in the hobby, but quickly turned into a 16-member club for young adults who look to the "geezers," as they call them, for advice.

The very articulate Andrew Be KJ0JZ is 14 years old, and is the president of ARFY. Andrew talked about the club's activities, including having a Web site [http://www.mesa.k12.co.us./mgm/arfy/].

Jonathan Chambers KB0TKD, age 16 (**Photo C**), described and showed slides of ARFY's DXpeditions to two US islands, 001R Skipper's Island and Watson Island 002R, both in the Colorado River. Both events exposed the kids to HF operating and gave them the excitement and experience of working huge pileups.

Denis Campbell AA0YX also came along from ARFY to describe some of the terrific experiences the young people are having in this group. To educate more kids about ham radio, the ARFY kids put on a series of classes at "Super Saturday," held at a local middle school. The kids put up a portable 50-foot tower in front of the school and let other kids get on and talk to people all over the country.

At the end of the forum I had my friend Bob Grove from *Monitoring Times* magazine draw for the winner of an ICOM dual-band radio. ICOM is usually represented at my forums by Chris Lougee, who has been supportive of my efforts with children in ham radio for many years. My thanks to all the manufacturers who help add that extra touch of excitement to the youth forum each year by putting radios into the hands of young adults.

Be sure to be on the lookout for young people who would enjoy being presenters at Dayton next year. Have them get in touch with me at the address at the top of my column or at [wb2mgp@ix.netcom.com].

Photo B. *Andy W5ACM and Mike WA5TWT try out the Yaesu FT-847 for portable satellite contacts while out on a fishing trip in central Texas.*

AMSAT accepted cancellation of their launch contract with the ESA, provided that ESA would carry Phase 3D as a backup on AR503 if no paying customer could be identified. In the event that a paying customer could be found for AR503, the ESA agreed to use best efforts to provide a ride for Phase 3D on another flight. When Arianespace bought the spot on AR503, AMSAT was left out, and now is looking to the ESA to provide a future launch opportunity.

The AMSAT organizations involved with the design and construction of Phase 3D are in agreement for some near-term plans for the now-grounded satellite. The first order of business is to complete any last-minute issues in the satellite systems. They will also provide travel, lab and storage insurance for the satellite. Phase 3D will then go through vibration and vacuum testing, followed by possible shipment to Germany. The AMSAT Phase 3D lab in Orlando, Florida, cannot be kept open indefinitely—the building itself is scheduled for replacement next year. While in Germany, the satellite can be checked and maintained in anticipation of a launch either next year or the year after. In the meantime, other launchers from other countries will be investigated as possible rides to orbit should the ESA fail to offer an alternative.

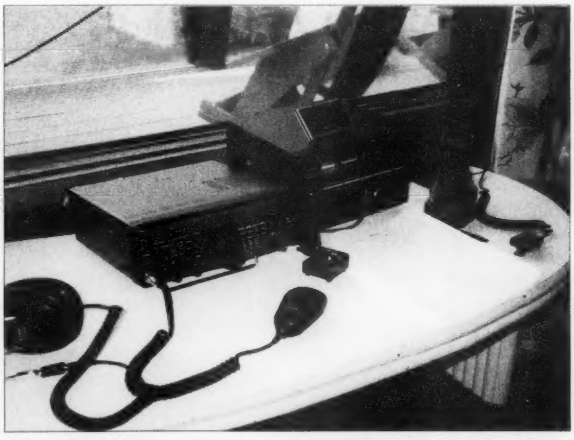

Photo C. *A close-up of the Yaesu FT-847 portable station with the FP-1030A power supply and a Whiterook Products Company keyer paddle (Model MK-44).*

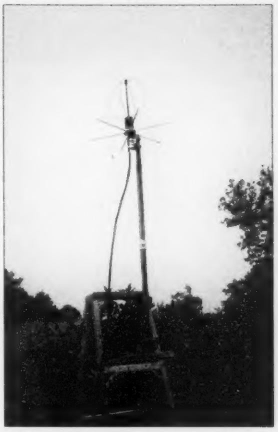

Photo D. *The M-Squared 70 cm "Eggbeater" antenna provided reasonable satellite reception and was easily mounted to a spare stepladder.*

Fun stuff

It's not always convenient to take a full-sized hamsat Earth station along on camping trips, vacations, or just on the road for some mobile fun. The radios, associated power source, and normal satellite antennas are just too large and heavy. A high-end home station may have two or three radios for HF, VHF and UHF. Power amplifiers, preamplifiers and a large DC supply may also be present. For antennas, the station might include dipoles, verticals or beams for HF, and an array of high-gain, circularly-polarized yagis on azimuth/elevation rotators for VHF and UHF. Getting this much equipment in a car is hard. Getting it all operational for mobile work yields cover pictures for ham radio magazines.

There are alternatives. For camping, where power is at a premium, HTs and other similarly-sized radios can provide a means to get signals up to and down from low-Earth-orbit satellites. On a recent Boy Scout camping trip I tried RS-12 Mode A operation (two meters up and 10 meters down) with a minimal portable station. On the uplink a two-meter HT was employed with a 5/8-wave whip. The one-watt FM radio was keyed on and off with a standard key. I had successfully tested this HT for CW chirp. It had a relatively clean signal (many HTs do not). On the downlink, I use a Grundig Yacht Boy 400 general-coverage receiver. I could hear my signal through the transponder, but the system was not sufficient for good contacts. While the uplink was adequate when the transponder was lightly loaded, the downlink reception was poor. The short built-in whip antenna on the Grundig was not up to the job. A good dipole strung in the trees would have made quite a difference.

During a fishing trip to central Texas I again used omni antennas, but took along the new Yaesu FT-847 satellite radio. This rig has 100 watts out on HF and six meters, and 50 watts out on two meters and 70 cm. It also has built-in preamplifiers. This time a good dipole was strung up for 10 meters. An old Ringo Ranger was used for two meters and an M-Squared 70 cm "Eggbeater" antenna (Model EB-432) was mounted on a stepladder with the optional reflector kit (Model RK-70).

The rig, microphone and Whiterook Products Company keyer paddle (Model MK-44) all fit in a large briefcase with room for satellite prediction listings and other items. The rig performed flawlessly. The extra power on the uplink and the built-in, low-noise preamplifiers overcame the deficiencies of the omni antennas, and many

Continued on page 50

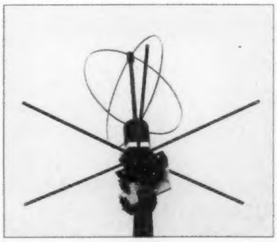

Photo E. *A close-up of the M-Squared 70 cm "Eggbeater" antenna (Model EB-432) with the optional reflector kit (Model RK-70).*

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NEW PRODUCTS

Elmers, Take Note!

The new MFJ-414 tutor is "the Cadillac of Morse code trainers," designed for professional classroom use. It's ideal for VE examiners, ham radio classes, clubs, Elmers … well, everyone who wants the best Morse code tutor available.

Features include an LCD readout and printer port, which is useful for printing out correct answers so that students can check copy after a code practice session. If a student is having trouble with certain characters, you can build and save three custom sets (16 characters each) for extra practice. The MFJ-414 will also store up to 16 FCC exams; you can generate actual FCC exams and download them to the MFJ-414 to test future hams and upgrades.

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You can use the powerful built-in speaker or external speaker or headphones. The MFJ-414 includes a serial port cable and open-end patch cable, and, as always, MFJ's famous *No Matter What*™ one-year limited warranty.

To order or for information about your nearest dealer, call (800) 647-1800; FAX (601) 323-6551; E-mail [mfj@mfjenterprises.com]; or check out dealer and ordering information on the Web site at [http://www.mfjenterprises.com].

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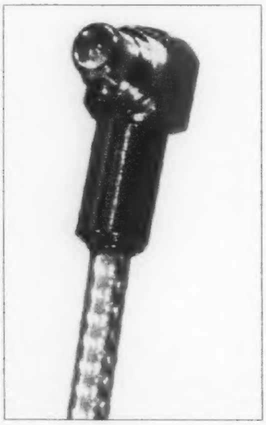

OK, so it's not really Egyptian funerary art, but it *is* gold-plated, and it looks like it might have been found in some ancient tomb … oh, all right—you guys are so stuffy sometimes!

What it really is, is the RFX-9010-1A, an example of one of the new MMCX connectors from RF Connectors, designed for use in applications where space constraints mean minimal sizes of RG178/U cable connectors. Straight and right-angle styles are available in PCB, crimp plug and jack configurations, and made of brass with nickel or gold-plated bodies, gold-plated contacts and Teflon™ insulation. See your RF Connectors distributor, or for additional information call (800) 233-1728.

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Ever since Hamtronics announced its new line of VHF FM exciter and receivers using new low-noise frequency synthesis technology, customers have demanded to know when they'd be available for the UHF bands. The wait is over.

The new T304 exciter and R304 receiver provide high-quality NBFM and FSK operation for UHF ham bands in the 420–450 MHz range and for adjacent bands from 400–470 MHz. Features include dip switch frequency selection, low phase noise synthesizer for applications, and more.

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For more information, check the Hamtronics Web site at [http://www.hamtronics.com], which includes all the Hamtronics gear; or for a printed catalog, write to Hamtronics, Inc., 65-D Moul Road, Hilton NY 14468-9535. You can also call (716) 392-9430; FAX (716) 392-9420; or E-mail [jv@hamtronics.com]. And let 'em know you saw it in *73*!

New Title!

The ARRL experts have put together the definitive compilation of advice and information on every type of interference, from automotive to lamps to VCRs to stereos to your station receiver—well, if it can be affected by interference, you'll find practical solutions in *The ARRL RFI Book*.

The previous ARRL interference book, *Radio Frequency Interference, How to Find It and Fix It*, has been thoroughly rewritten for the most up-to-date answers about problems, cures, and RFI regulations, and the suppliers list and bibliography have been extensively updated.

Order ARRL #6834 from ARRL, 225 Main Street, Newington CT 06111, or see your dealer.

PacTerm 98

Kantronics and Creative Services Software have teamed up to produce a new 32-bit Windows terminal program for the Kantronics TNC. PacTerm 98 requires Windows 95®, Windows 98®, or Windows NT® with eight meg of RAM and six megabytes of free hard drive space. The program supports Com1 through Com35 and has point-and-click commands for the VHF and HF modes that the Kantronics TNCs support.

From CW to HF packet, it's now even more fun to use the digital modes of amateur radio. Capabilities include: G-TOR monitoring; stream selection with a click of the mouse; text and binary file transfers; user-defined colors and fonts for received, transmitted, and command text; mini-logging program; support for CD-ROM-based Callbooks—and lots more!

The suggested retail price of the PacTerm 98 is $69.95. You can check the Web sites at [http://www.kantronics.com] and [http://www.cssincorp.com] for further details and purchasing information.

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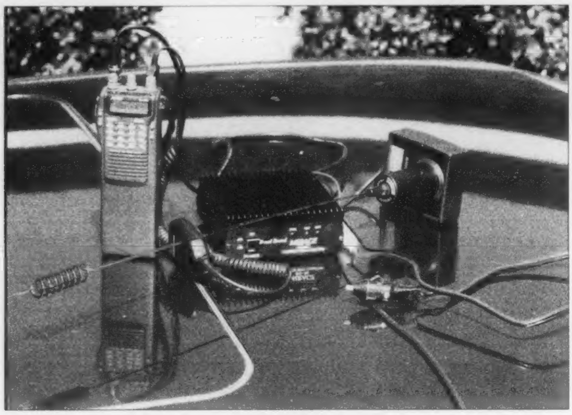

Photo F. *The mobile* A-O-27 *station at W5ACM includes an Alinco DJ-580T HT with dual-band Mirage BD-35 amplifier and Larsen dual-band mobile whip (Model NMO 2/70 B).*

HAMSATS

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contacts were made during the four-day trip.

Reception on the Eggbeater was sometimes difficult while chasing the 70 cm downlink signals from *Fuji-OSCARs 20* and *29*, but was reasonable for most of the passes from *AMRAD-OSCAR-27*. For home use, this antenna might work better when placed in a high, clear spot. The stepladder only got the antenna about eight feet above the porch, while the two-meter Ringo Ranger was mounted above the chimney. We also caught a lot of fish.

In early June I had an opportunity to watch Keith Pugh W5IU, AMSAT Vice President of Operations, make a number of good contacts via *A-O-27*, using only a five-watt, dual-band HT and an Arrow dual-band hand-held beam. *A-O-27* provides a single-channel, Mode J (two meters up and 70 cm down) FM transponder that is active for daylight passes over North America. Keith's demonstration was part of the satellite seminar at the Arlington HAMCOM between Dallas and Fort Worth TX.

The Arrow beam's gain and easy maneuverability really helped both the uplink and downlink signals. The gain on 70 cm is greater than that on two meters, and the beam width of the 70 cm portion is narrower. When signals are best for 70 cm reception, they will be excellent for the two-meter uplink.

After Keith's demonstration I was once again excited about mobile and portable *A-O-27* contacts. Some of the distributors at HAMCOM had Maha MH-A201 dual-band power amplifiers on sale. The literature stated that they would allow full duplex operation, so that I could transmit on two meters while receiving on 70 cm with my dual-band FM HT. Power output on two meters was listed as 45 watts for three watts input. I was finally ready to buy, but they were all sold out. I then learned that the Mirage BD-35 dual-band amplifier was not only the same price, specifications, and appearance as the Maha MH-A201, but it was probably made in the same factory in Taiwan. A few were left, and I got one.

My mobile *A-O-27* station consisted of an Alinco DJ-580T HT, the new Mirage amplifier and a Larsen dual-band mobile whip antenna (Model NMO 2/70 B). During spare time on the Monday after HAMCOM I gave it a try. On the first pass a few brief contacts were made, but they were not easy. During the second satellite pass I tried moving the antenna around for best signal reception. This worked much better. Signal levels were up and the fades noted on the first pass could be avoided simply by adjusting the antenna's orientation. It was a lot like operation with the Arrow beam, but with less gain. A few Eggbeaters on the car might be a good experiment for next time.

VUCC

Contacts on the low-Earth-orbit satellites have changed over the years. They are still somewhat brief, but grid squares are second only in importance to callsigns. Some stations don't even bother with states and cities for the exchange, just grids. Interest in the American Radio Relay League (ARRL) VHF/UHF Century Club Award (VUCC) has found an attentive audience on the amateur satellites.

The satellite version of the award is given for confirmed contacts with stations in 100 different Maidenhead (two degrees by one degree) grid locators. All confirmed contacts must be made after January 1, 1983. Full details can be found via the Internet at the Universal Resource Locator (URL): [http://www.arrl.org/awards/vucc/]. The site describes the awards and the rules, and provides application forms for printing and mailing.

Many of the portable/mobile *A-O-27* enthusiasts have taken the time to go out to rare grids and make them available during satellite passes. This activity has also been noted on *Fuji-OSCAR-20* and *29*. Although the equipment (SSB and CW gear) is sometimes more bulky, expensive and complex than dual-band FM rigs for *A-O-27* work, there have been a few operators taking it on the road. Listen for them, or better yet, plan your own portable operation for your next vacation, camping expedition, or road trip.

Be sure to park the vehicle, if you are mobile, prior to making satellite contacts. It's bad enough avoiding those folks with cellular phones glued to their ears while they try to drive.

Photo G. *Gary KD5DAY holds a dual-band Arrow beam while Keith W5IU gets ready for an* A-O-27 *pass at HAMCOM across the street from Texas Stadium in Arlington.*

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The Italian connection

English novelist Edward M. Forster wrote that a trip to Italy can be an education in how to live well. For the most part, he was right. April WA6OPS and I have just returned from 10 days there and our minds are still reeling with images of the beautiful artwork and architecture in cathedrals and museums, not to mention the great food. Unfortunately, we also experienced the world's worst traffic, or so it seemed.

The proudly displayed works of Leonardo da Vinci, Michelangelo, Donatello, and countless other artists are justifiably renowned, but many other Italians have had greater influence on the way we live our lives today. To radio enthusiasts, none can top Guglielmo Marconi (**Photo A**).

Marconi was not the first to transmit electricity through space using periodic oscillations. That was done by Heinrich Hertz in 1888, giving rise to the term "Hertzian waves." Marconi was age 14 and attending the Technical Institute in Livorno at the time. When he heard of Hertz's experiments, he began to dream of sending signals for long distances and making money at it. He already knew the Morse code, so the idea of a wireless telegraph for ships at sea was the next logical step.

Little Guglielmo spent hours reading about Hertz and others who were setting the stage for the advent of electronics and radio. Many of them were fellow Italians. For instance, zoologist Luigi Galvani had observed by accident that electrical waves could travel through space. As Galvani was testing an electrostatic machine, the hind legs of a frog several feet away began to twitch.

Augusto Righi had invented several radio wave sources and detectors at the University of Bologna. His shock-excited oscillators were two spheres spaced one-tenth of an inch from each other in paraffin oil, connected by inductors and charged by a spark coil. Although crude by today's standards, they were good enough to prove that light waves and waves at radio frequencies displayed similar properties.

Generating waves was important, but it was also necessary to have simple means to detect them. After all, it wouldn't be practical to equip all future receivers with frog's legs! Yet another Italian, Temistocle Calzecchi-Onesti, was the first to make a non-organic RF detector, called the coherer. It consisted of a small glass tube containing two electrodes and some metal filings. Sparks in the vicinity of the coherer caused increased conductivity (cohesion) of the filings. When the coherer's electrodes were wired in series with a bell and battery, detected Hertzian waves would cause the bell to ring. Unfortunately, it continued to ring when the incoming wave ceased, so the user had to tap it to release the cohesion.

At age 20, Marconi set out in earnest to achieve long-distance communication by electromagnetic waves. He convinced a professor at the University of Bologna to give him access to the physics library and laboratory, but he confined all his radio experimentation to an old attic, fearing that his ideas might be stolen and someone else would beat him to his goals. Though many of his early experiments failed, he persevered, creating more powerful oscillators and more sensitive coherers with automatic tappers. It's amazing that within three years he was able to make transmitters and receivers to cover 30 miles, considering that vacuum tubes, crystal detectors, and receiver tuning did not yet exist. Of course, receiving was easier for him because there were no other stations to cause QRM!

At the longwave frequencies of Marconi's early work, it became clear to him that the bigger the antenna system, the better. When he sent his first signals from England to France, the transmitting aerial had wires 150 feet high, extending across the English Channel, held up by lighthouses and naval vessels.

As every Big Gun DXer knows, "If your antenna didn't blow down last winter, it wasn't big enough." Sure enough, as Marconi's associates prepared for transatlantic tests in 1901, the large receiving antenna under construction in Newfoundland fell victim to a storm. Marconi immediately sailed to St. John's, where he replaced it with a 14-foot diameter balloon and trailing wire. The balloon was soon lost in a gale, whereupon Marconi launched a kite-borne aerial to complete the experiment.

The Bill Gates of wireless

Whereas most of the other radio pioneers were academic physicists, Marconi was an engineer and a businessman. His grades weren't good enough for him to become an enrolled university student, but he devoured books and spent countless hours of trial and error in his laboratory. There were many naysayers who insisted that long distance wireless was impossible because sunlight would create too much wave interference and that radio waves would not follow the curvature of the Earth.

A GUGLIELMO MARCONI
INVENTORE DELLA RADIO

Photo A. *Italians are proud of the accomplishments of Guglielmo Marconi and have erected many monuments to him. This one is in the Duomo Cathedral in Florence.*

Marconi simply ignored the critics. By 1910 he was DXing from Ireland to Argentina, and by 1918 his "countries worked" list included Australia. He deduced the inverse-square law of wave propagation, which led him to design ever higher powered spark transmitters. His early 24-watt rig got him two miles' range in 1896 and his first transatlantic transmissions were at 30 kilowatts, but he built 300 kW stations to provide reliability for his commercial transatlantic telegraph service that began in 1907. As technology developed, he moved his operations from longwaves to short-

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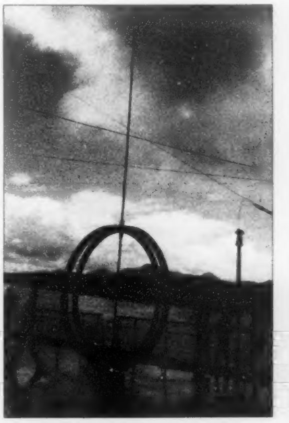

Photo B. *Shipboard CW operators aren't required nowadays, but the classic Bellini-Tosi dual-loop RDF antenna is still a common sight on vessels of all sizes.*

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waves, which permitted much greater daytime range.

Marconi carefully protected his inventions and sought to make them commercial successes all over the world. This was facilitated by his strong connections to the British. Although he was born in Bologna, his mother was from England, and he spent most of his early years there, learning English first. His first radio patent was in London, where he formed the Wireless Signal and Telegraph Company (later changed to Marconi Wireless Telegraphy Company) in 1896. Then came the Marconi Company of Genoa, Italy. He traveled to the US in 1899 to perform wireless experiments with US Navy ships, forming the American Marconi Company while here. In 1919, General Electric purchased the Marconi companies of Britain and the US, forming the Radio Corporation of America (RCA).

Successful people become targets, and Marconi was no exception. When his transmissions spanned the Atlantic, it was a blow to the Anglo-American Undersea Cable Company of Newfoundland, whose shares on the London Stock Exchange dropped precipitously. AAUC sued Marconi for damages, claiming that his purported DX reception was an error or perhaps even fraudulent. Although the government of Newfoundland promised support to Marconi, he decided it was best for business to move his New World operations to Cape Cod.

Marconi continued to invent new wireless components such as the time-spark system for generating continuous waves and a magnetic detector that replaced the finicky coherer. He also used the work of other scientists to build his empire, when needed, by purchasing rights to their patents. He established the Radiotelegraphy Institute at Frinton in 1901 to train operators and technicians for the new wireless telegraphy industry.

As shrewd as he was at business, Marconi sometimes misread the market. Believing that CW would suffice for all oceanic communications, he ignored the possibilities of voice modulation. That gave others, including Lee DeForest of the US, an opportunity to pave the way for AM and the broadcast industry.

Direction finding in the early days

Marconi's early wireless aerials were large metal objects such as sheets and cylinders. In 1895, he discovered that connecting one terminal of his transmitter's output to the aerial and the other to earth gave improved range. He also found that wire antennas worked better than large metal surfaces and that they had useful directional characteristics. In July 1905, Marconi's longwave directional antenna (an inverted-L) was patented.

In his experiments on signals transmitted from the *H.M.S. Furious* in 1906, Marconi tried an electrically-rotated directional antenna system consisting of several inverted-L's in a star configuration. Since the L's were each only about one-fifth wavelength long and very close to the ground, the directional effect was not very pronounced.

Marconi observed that propagation and radio direction finding (RDF) conditions were greatly affected by signal frequency. "Shortwaves behave like short quick ripples which hit a rock and come back," he stated, "while longer waves go beyond the rock by going around it." Today's transmitter hunters know he was right. Multipath (signal reflection) degradation of RDF accuracy becomes much greater as frequency goes up.

It was two fellow Italians, Ettore Bellini and Captain Tosi, who took the next giant step in RDF technology. They expanded on the earlier work of Pickard, who had shown that a small, vertically-oriented loop antenna had an excellent directional pattern for ground-wave propagated signals, characterized by broad lobes off the ends of the plane of the loop and a sharp null "through the loop."

Bellini and Tosi mounted two loops together, oriented at right angles, and invented a special coupler to combine their patterns at the receiver input. This coupling device, called a goniometer, made it possible to rotate the directional pattern in azimuth without the loops themselves moving. This was ideal for use on ships (**Photo B**). Inductive coupling is still used on goniometers for longwave and shortwave, with fixed coils attached to the loops and a rotating coil connected to the receiver. Marconi's enterprise bought rights to the Bellini-Tosi system in 1912.

Historians claim that RDF came of age when Captain H.J. Rounds of the Marconi Company installed a chain of wireless stations on the coast of England. Operators are said to have used their RDF antennas to detect movement of German warships in May 1916. Britain's First Sea Lord, Sir Henry Jackson, then sent his fleet of 35 ships into action at the Battle of Jutland against 28 German vessels. The Brits suffered greatest losses, but they forced the German fleet to retreat to port, where it remained for the rest of that war.

Sir Henry credited the newly-installed RDF stations for detecting the movement that caused him to commit to battle. However, some historians believe that this was disinformation, intended to cover the fact that cryptanalysts had cracked the Germans' naval ciphers and intercepted messages to the U-boats about a rendezvous at sea. The code-breaking scenario appears more plausible, because the fleet's initial movements, over 300 miles from the RDF stations, would have changed their bearings by less than one degree. Whatever the case, the sensitive receivers and highly directional antennas of Marconi's installation made possible the interception of enemy transmissions.

RDF becomes a sport

Amateur radio operators in the US experimented with directional antennas from the early days of our hobby, mostly as a way of avoiding QRM. The September 1923 issue of *QST* announced a hidden transmitter hunt as a feature of the Second National ARRL Convention in Chicago, but RDF did not become an important activity for almost three decades.

In the late 1940s, announcements of several ARRL division conventions invited attendees to bring along crystal detectors and earphones so they could participate in the two-meter transmitter hunts. Judging by the number of *QST* magazine announcements, there were probably more hidden transmitter hunts at these conventions in 1948 than there will be at ARRL conventions in 1998. Apparently, a diode, earphone, and antenna wire were the only things needed to receive and track those signals. This was before my time (almost), so if you went on these postwar hunts, please write and tell me about them.

The 1950s brought a flurry of mobile T-hunting on 10 and 75 meters. Bulky batteries, tubes, and noisy dynamometers didn't keep hiders from concealing their Ts in picnic baskets and using fishing poles as camouflage whip antennas. By the 1970s, most transmitter hunting in the US was done in cars on two meters, taking advantage of smaller and more sensitive solid-state gear. Meanwhile, Europeans began doing their RDF contests on foot, first on 80 meters and later adding two-meter events.

Nowadays, organized on-foot foxhunting (also called radio-orienteering and ARDF) is a popular ham activity in most countries of Europe. However, I found very little of it in Italy. There is no national ARDF organization in place. The country's last ARDF coordinator passed away and a successor has not been named. A few stalwarts continue to participate and

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O.B.E.

Those of you with a military background may recognize the title of this month's column as the abbreviation for "Overcome by Events," or put another way, "The best laid plans of mice and men ..." I had originally planned on writing about a different topic, but some recent events have caused me to change directions.

Shortly before this column was written a single satellite malfunctioned; the malfunction knocked out many pagers throughout the country. It also affected other relatively routine functions—such as credit card payments at gas stations. It was surprising to see how far the ripples spread from a single problem with a single satellite. With our technology today affecting most parts of our lives and with the technology itself being so advanced, we are very vulnerable to large disruptions caused by the smallest malfunctions. If this is a taste of a small problem, what larger problems might be looming out there? How about the Y2K bug? As everyone knows by now, when the calendar turns to January 1, 2000, some computers which store the year portion of a date as only two digits will see the date as January 1, 1900. Although people have been aware of this problem for years, many business and government officials have been reluctant to put other plans and projects on hold to spend the money to correct this bug. If a stitch in time saves nine, this problem may require a major reweave to correct it, since we've done so little to date. Very few organizations are completely prepared, and this bug may affect everything from navigation aids for planes and boats to the programming of your VCR.

In the last few weeks it has become known that although many businesses have fixed the problem in their computers (which prepare bills), they have not addressed the problem with many embedded processors—those processors that are built into systems and equipment. As surprising as it may seem, many industries did not even think that this area would need attention, including many power companies and other utilities. As a result, the expectation now is that the electrical power industry fully expects to lose power for some unknown period of time when the millennium bug kicks in. They now say it is not a question of *if*, but a question of how bad, for how long? I suspect that if they are admitting this a year and a half before the problem will occur, the situation may be more serious than previously believed.

Talk about ripples! A major loss of power will create a significant series of additional problems. Naturally this will include loss of heating or cooling for many people, as well as the ability to store and prepare foods. One of the biggest headaches with any loss of power is traffic control when the traffic signals cease to function, increasing accidents, slowing traffic to a crawl—and, eventually, stalling entire cities in gridlock.

But what if the Y2K bug creates problems with the telephone system? Telephone service may be affected as many people attempt to use the phone system to check on friends and relatives or just to kill time. In addition, telephone systems are highly computer-dependent, and even if the major carriers address these problems, localized issues can be significant. Many business systems would be affected, of course, but what impact might we expect on the phone systems or the computers used at the 911 consoles—which normally direct police and fire responses? As I was wondering about these issues, I received a very interesting E-mail from Joe Moell K0OV, who made some comments about a previous column. I had suggested that hospitals might provide an avenue for disaster drills, but Joe pointed out that there are many smaller situations in which hams can be of assistance. Many hospitals use telephone systems which are computer-dependent and these could be vulnerable to any major problems such as Y2K. While hams may be called upon to help in such crises, there are many other opportunities to provide communications support on a more routine basis. The hospital phone systems need both software and hardware to be updated on a periodic basis, something often scheduled for the middle of the night to minimize disruption. While the upgrades are installed, the entire telephone system may need to be taken down. This provides an excellent opportunity for hams to be of assistance.

During the telephone outage, hams can be stationed at key locations where services may be needed, such as the Emergency Department, Intensive Care, etc. They also are stationed at locations which provide those services, such as laboratory, radiology, the blood bank, etc. Liaisons may also be assigned to the administrator on duty, or other key personnel. This allows the senior manager on site to monitor what activity is occurring, and how the needs are being addressed. If area hams assist local hospitals on a regular basis,

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promote the sport, such as Francesco Lancellotta IK8VWA of Macerata. Plans for his rugged hand-held two-meter ARDF beam were featured in *73 Magazine* in May 1998.

Annual foxhunts are held in a few communities in northern Italy, but they do not follow international rules. "Transmitter power is only about ten milliwatts, and the foxes are usually less than 400 meters away," explains Piero IK2VTJ, who lives near beautiful Lake Garda. Organizers make sure that extra equipment is available so that visitors to these events can be introduced to the sport of ARDF.

T-hunting in cars is also done occasionally in some parts of Italy. IK2VTJ likes both on-foot and mobile hunts. In the tradition of his inventive countrymen many decades ago, he is building an electronically rotated RDF antenna system for his car. His goniometer is for two meters and uses switches instead of transformers. You can see it on his Web page, reachable via a link from our "Homing In" site.

Cheer for the US!

The time is near for the Tenth ARDF World Championships in Hungary, scheduled for the first week of September. Italy won't be sending a team, but about two dozen other countries will, and the US will be represented for the first time. Watch for the results and stories of the action in future "Homing In" columns. Meanwhile, keep sending me your RDF news, including results and photos of your local transmitter hunts, both mobile and on foot. Electronic and postal mail addresses are at the beginning of this article. Good luck on the hunt!

it will be much smoother should they face a major problem. While it is true that during a routine switchover a handful of cellular phones could handle the situation, during a major communications problem, the cellular system may be affected as well.

Joe wrote how the Hospital Disaster Support Communications System (HDSCS) of Orange County, with 90 members, has been providing backup communications for hospitals for 18 years. This shows good interaction between hams and the hospitals, as well great preparation. Does your club or group plan on such eventualities? Now may be the time. Incidentally, if you're curious about this, check out the HDSCS Web site at [http://members.aol.com/emcom4hosp/].

With many phone systems so computer-dependent, and with computers subject to the Y2K problem, this is an area in which problems can be expected and amateur radio can be a help. The key is to get involved now with local hospitals to ensure that we know what we need to do and have the resources to do it if (?) and when we're needed. Does your club or group have a liaison with the local hospitals? Do they know how to contact the area amateurs?

I guess the key issue is that sometimes we spend so much time planning for the problems we know—tornadoes, hurricanes, blizzards, etc., we forget that as we progress, other disasters may be awaiting us. The Y2K problem is just one. In the past few weeks I've heard more disaster services folks speak of *La Niña* and its ramifications—including the possibility of tsunamis hitting the continental US. We've got our work cut out for us.

Number 54 on your Feedback card

QRP

Low Power Operation

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When NorCal introduced the 38 Special, it was an instant hit. The club sold over 2000 38 Specials before production was halted. That's a lot of building and soldering!

What is the 38 Special?

The 38 Special is a small 30-meter superhet transceiver. It was designed by Ori Mizrahi-Shalom AC6AN. This rig really was an exercise in minimization. But more important, the 38 Special served as a base on which many, many modifications were installed.

An interesting aspect of the 38 Special is the lack of bunches of discrete transistors. Most of the "magic" of radio is done with the help of ICs—even the final amplifier used an IC.

Although the 38 Special is loosely based on the 40-9er, there are only two NE602 mixers used. A little magic with a 4066 allows one crystal mixer to be used either as the transmit mixer or the BFO for the product detector.

The 38 Special has an input filter and a brute force RF gain control to keep out unwanted signals. The front end is also where the T/R switching diodes are placed. There are no relays used in the 38 Special. It uses a VXO for controlling its frequency. By using a mix of design goals and off-the-shelf components, the VXO can swing about 20–25 kHz.

In keeping with the design goal of using off-the-shelf components, the IF filter consists of a single crystal with a handful of caps. Although a bit wide, it works for such a simple design.

The RF amplifier has an output of about 500 milliwatts. There are on-board pads and traces to install an optional five-watt RF amplifier.

Although the 38 Special was extremely popular, NorCal no longer markets the kit—so you're out of luck if you want a 38 Special.

The reason I wanted to give you an overview of the circuit is to help you follow along, because we're going to do some troubleshooting and repair on a 38 Special transceiver.

Right now, I'm working on a 38 Special that was given to me by a ham. Since I didn't build the rig myself, it has proven to be an interesting project.

Before we begin

Before we get started in the internal workings of the 38 Special, there is a new kit being produced by NorCal. Since the new one was scheduled for August release, it seemed like a good time to start spreading the word, so here is the info about the latest NorCal kit, the NorCal 20, supplied by Doug Hendricks KI6DS.

The NorCal QRP Club is pleased to announce its newest kit, the NorCal 20, designed by Dave Fifield AD6AY. The NorCal 20 is a 20-meter CW transceiver with the following features:

- Superhet receiver.
- TUF-1 mixer for the front end (designed for the harshest European conditions), *not* another NE602 front end.
- Variable output power from 0–5 W.
- VFO controlled, user bandwidth-selectable from 10 kHz to 200 kHz on any portion of the 20-meter band. This means that if you only want your VFO to cover 25 kHz of the band, you may set it up to do just that.
- Varactor-tuned VFO, 10 k pot supplied, but board laid out for 10-turn pot.
- Self-contained keyer, custom-designed for NorCal by Embedded Research.
- LM380N 2 W audio chip; easily drives a speaker.
- Frequency readout via audio frequency annunciator.
- A PIC chip is used as a frequency counter with audio output. In the automatic mode, as you tune the radio, a beep is generated every kHz. Then, when you stop, the last two digits of your frequency are announced in Morse code. You may also push a button to generate the frequency that you are on.

The manual mode does not have the beeps and you must push the button to get your frequency (designed by Mike Gipe K1MG).

- Custom clamshell case, made from .090 aluminum, four and a half by four and a quarter by two and a quarter inches, designed by Bill Jones KD7S, and made by Doug Hauff KE6RIE.
- All controls, knobs and connectors are supplied.
- Double-sided, plated-through, solder-masked, silkscreened board, commercial quality.
- Comprehensive manual, written in the "build-a-section, test-a-section" style.
- Five-pole crystal filter.
- 220 board-mounted parts, no surface mount.
- Full QSK, NO relays.
- IRF510 final, 2N4427 driver.

Only 500 of these kits will be available, and orders will be accepted after August 1st. There will only be one run, and there will not be another. NorCal will no longer produce unlimited kits. The price is $95 for the kit, plus $5 shipping and handling in the US, $10 DX to Canada and Europe, $15 to Asia and the Pacific Rim. Payment must be in US funds only, and checks must be made out to Jim Cates, not NorCal. European members may order from NorCal's European agent, Stephen Farthing, and the price is £70 (70 pounds sterling). The kits will be shipped

Number 55 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
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Stevenson MD 21153
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How do you describe Labor Day? On one hand, it represents the symbolic end of summer. On the other, it is the beginning of the school year. This time of year seems like a natural time to look for help and new ways to do things.

A time-honored tradition among hams is the "Elmer." This is an affectionate name for hams willing to help hams. In the days of widespread active ham clubs, finding such an individual was easy. Now, it's much more of a challenge.

Enter the Elmers Web site, on the Netmeg Internet service. Here you will find a long list of individuals who have offered to help in this way or that. In alphabetical order, you will find people willing to help with everything from basic ham radio topics through radioteletype, packet, amateur television, and other exotic topics. Check it out at [http://www.netmeg.net/faq/recreation/radio/ham-radio/elmers/].

Another fellow who has set out to help the online ham community is Andrew Tumanov, who has created the "raDioWavE" site. On this Web site you will find a full complement of links to a wide range of amateur radio resources, downloadable software, and special events. This one clearly belongs on your bookmark list. Take a look at this one at [http://www.estpak.ee/~andrew/index.htm].

A scholarly set of links was put together under the banner of "AmSoft—The World of Ham Radio's Missing Links." Well, they are not exactly missing, just missed by most hams on the prowl for information. Here is an authoritative text on phonetic alphabets, telegraph keys through the ages, hamfests, magazines, and more and more. You might find just what you are looking for at [http://hamster.ivey.uwo.ca/~amsoft/amsoft0.htm].

Is that it? Hardly! A British site is another with a long list of amateur radio links. This one is unique in its featuring of both British and specialty manufacturing sites. For your guidance, the URL of this site is [http://www.g4dvj.demon.co.uk/radio.htm].

Are all the sites of interest only in English? Of course not! Here is a site called *Kurzwelle*, that's "Shortwave" in German. The major feature of this site is

Continued on page 62

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after Pacificon, with a projected shipping date of Oct. 20, 1998.

The exciting part of this project is that for every kit sold, NorCal will produce a second kit and send it to the G-QRP Club, which will handle distribution to hams in third world countries at no charge to the receiving hams. They will give the kits away! 500 kits sold equals 500 kits for third world hams. George Dobbs has been selected to handle the distribution of the third world kits because of his extensive network of contacts with hams in these countries. Every effort will be made to assure that the kits get to deserving hams.

This is a huge project, and one that has never been done successfully before. The NorCal has been designed to be easy to build with minimal test equipment, yet to be a quality radio capable of worldwide contacts when finished. Dave AD6AY has many years of experience of operating in Europe, and is very familiar with the requirements of radios in that environment. He has designed the front end with the operating environment in mind.

George Dobbs suggested last summer that NorCal come up with a way to provide kits for needy hams in third world countries—and they've done it. The NorCal 20 team of Dave Fifield, George Dobbs, Jim Cates, Mike Gipe, Doug Hauff, Gary Diana, Brad Mitchell, Bill Jones, Richard Fisher, Jerry Parker, Paul Harden and Doug Hendricks have worked very hard to ensure success.

Remember, no checks were accepted until August 1st, to be sure that everyone had a chance to learn of the project and had an opportunity to buy a kit. To order, please send your check and a self-addressed mailing label to:

Jim Cates
3241 Eastwood Rd.
Sacramento CA 95821

European customers may choose to send their orders (in British pounds sterling) to:

Stephen Farthing
38 Duxford Close
Melksham, Wiltshire
SN12 6XN
England

Wow! Looks like this is going to be a project and a half. If you want one, you had better order the kit as soon as you can. There will not be a second run made by NorCal.

Looks like I'm out of room, so next month we'll dig into the NorCal 38 Special. You might want to keep this issue handy, as it will be referred to as we work on the rig.

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Multibanding the Fracvert Half-wave

Here's a wire vertical with surprising performance on 40–10 m.

Chip Cohen N1IR
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Belmont MA 02178
[fractenna@aol.com]

In the search for a simple, high performance, multiband HF antenna, the choices are pretty limited. Topping the list is the G5RV, a dipole with a radiating ladderline section on some bands. I've never been crazy about the power pattern on this antenna and, given the fact that it needs a tuner, it struck me that other tuner options beyond a droopy longwire must be around.

Of course, the solution is often under your nose. Having spent considerable research efforts on fractal antennas, I decided to play with a very simple one. Fractal antennas are shaped antennas that are "bent" in some self-similar way. Each time you do a scale of bending, it's called an iteration. The effect is to produce something akin to linear loading, but on many scales of size. Fractal loading has proved an efficient way of making smaller antennas.

But another effect caused by fractal bending is phasing—and gain. The simplest example is when the bending is done on just one scale—effectively, a stub. Applying a three-sided box stub in the middle of a dipole yields a Cohen dipole, an echelon antenna optimized for performance using shaped antenna and fractal ideas. It is high-gain: over 4 dB when compared to a regular dipole. The tradeoff for this example is size, though. The Cohen dipole is one wave in its biggest dimension.

My Fracvert Half-wave is half a Cohen dipole, fitted as a monopole. It is a "try me" antenna: As a first-iteration fractal it was designed to get hams to think about the fractal possibilities. For those who prefer something more familiar than fractal geometry, its stub and echelon nature are adequate reasons for playing with it. And if those don't work, then the performance will. Gentlemen's bet: After you try this antenna, you will wonder what to do with your G5RV and dipoles and longwires. I can guarantee you that with 35 feet of height and a footprint of 35 feet for the radials, you will be extremely pleased with the results of your effort.

What does the antenna look like? It's a wire vertical with a dogleg. I show it in **Fig. 1** over eight radials cut for 20 m. For lengths in waves and feet, I've prepared **Table 1**. The antenna has a half wave of height on 20 m. It has full bandwidth and a flat VSWR on 20 m as shown in **Fig. 2** (all modeling done with NEC4), so if you scale the dimensions for 40 m, for example, you will get the same specifications.

Its gain was modeled over perfect ground with NEC4 (see **Fig. 3**), where ideally it shows over 4 dB gain over a quarter-wave vertical. It has gain over a half-wave vertical, too. But unlike the quarter- and half-wave verticals,

FracVert Dimensions for 20 m (14.15 MHz)

Section	Length (waves)	Length (feet)
Feed Section (vertical)	0.17	11.8
Horizontal Section	0.25	17.4
Top Section (vertical)	0.33	23.6

***Table 1.** Fracvert dimensions for 20 m (14.15 MHz). All radials are 1/4-wave. All wires are #12 copper.*

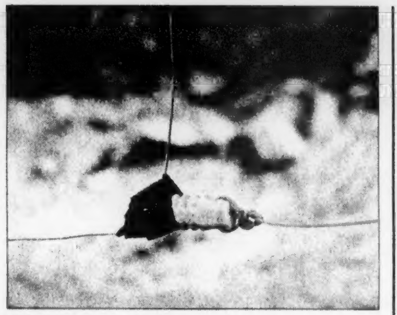

Photo A. Anchoring an elbow.

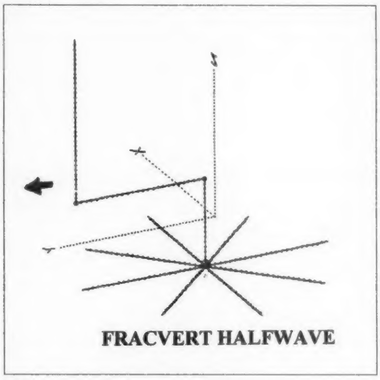

Fig. 1. The Fracvert Half-wave.

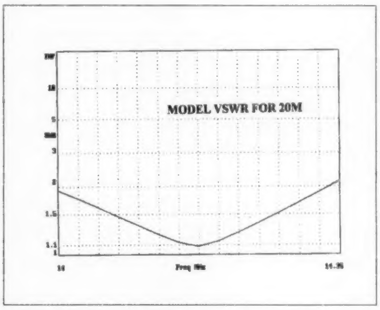

Fig. 2. Model VSWR for 20 m.

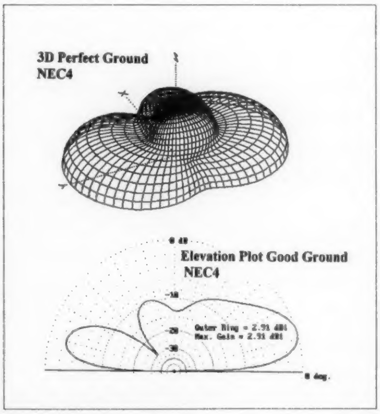

Fig. 3. NEC4 models.

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Same Height Vertical Comparison				
	Fracvert Half-Wave (20 m)		**1/4-Wave Vertical (40 m)**	
Band	Field Strength (dBi)	Az. Pattern	Field Strength (dBi)	Az. Pattern
40	-0.3	omni	-0.4	omni
30	0.1	Bi/omni	0	omni
20	2.9	Bi	0.7	omni
17	1.7	Bi	-0.5	omni
15	3.8	Bi (rotated)	3.5	omni
12	3.5	Bi (rotated)	4.3	omni
10	4.6	Bi	4.7	omni

***Table 2.** Same height vertical comparison.*

this antenna's pattern is bidirectional like that of a dipole. Over real ground with good conductivity, the modeled pattern is a slightly asymmetric and bidirectional, also shown in **Fig. 3**, favoring the direction of the dogleg. View the Fracvert Half-wave as a very simple, resonant, coil-less, high gain vertical on 20 m and you already have a winner. And did someone say cheap? My costs were under $15, including ferrite chokes.

Brandishing an antenna tuner, more fun is to be had. On 30, 17, 15, 12, and 10 m, the antenna has practical gain over a quarter-wave vertical cut for those wavelengths. But as this is not a good comparison, I chose a 40 m quarter-wave vertical, equal in height to the 20 m Fracvert, and simulated its multiband operation. If you want to measure the better of two 35-foot verticals, this is a meaningful comparison.

Table 2 compares the quarter-wave vertical for 40 m and the Fracvert cut for 20 m. These field strengths don't include the insertion loss from the antenna tuner loading, but with a good tuner these losses will be minor and comparable for each of the two antennas. Note that I had to place the 40 m vertical over a much larger radial footprint, and the field strengths include losses over good ground.

What's clear from the data is that the Fracvert beats loading up a conventional vertical of the same height, often by a substantial margin. Furthermore, the Fracvert consistently has low takeoff angles (best for DX). Especially on 15, 12, and 10 m is this true; the higher gain numbers for the 40 m vertical are at moderate to high elevations and not useful for DX.

Some construction details are in order. All are no-brainers. One of the main issues at hand is how to support

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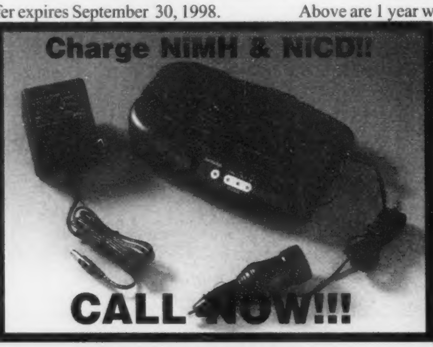

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the two "elbows." I did this by passing the wire through an insulator and anchoring the other end, as shown in **Photo A**. Another one is how to orient the antenna. On 20 m, the maximum gain is in the same direction (outgoing; see the arrow in **Fig. 1**) as the stub. On 15 and 12 m, it's at a right angle to it. I've indicated this as "rotated" in **Table 2**.

There are no tricks on feed attachment. Just make a radial harness and solder to the braid, and solder the center connector to the dogleg at the bottom of the feed section. Special note: Choke the coax with ferrite or a line isolator just to make sure that the coax doesn't radiate. The antenna is certainly unbalanced when not in use on 20 m, so a choke is imperative.

An intriguing possibility is true 80–10 operation for the Fracvert Half-wave. If the antenna is cut for 40 m and you have the 70 or so feet of height, then the antenna will work on all these bands.

The performance has been excellent with this antenna. I use it on 40–10 m as my default antenna these days (when not experimenting with others). In fact, I occasionally throw up its mate, with this second dogleg pointed 90 degrees off to get more coverage. I kick in the antenna tuner to match for all bands except 20 m, where the 1.2 VSWR is so good I just take the tuner out of line. My experience is that I typically beat tribanders at 35–45 feet with ease in the direction favored by the Fracvert Half-wave.

Of course, I'm not the only one who uses a Fracvert Half-wave. TT8JWM put up a Fracvert on 20 m last year and was "*very* impressed." About 100 hams so far have used them and sent me glowing E-mail. The antenna may be available commercially later (its patent is pending), but for now all hams are welcome to make their own and experiment with the multiband capabilities.

QRX

continued from page 8

meeting, ARRL President Rod Stafford W6ROD observed, "The debate was at times contentious and the result was not unanimous. Some board members preferred greater simplification; others were uncomfortable with some of the changes being proposed. However, every board member, without exception, left the meeting knowing that each of his or her colleagues did what they believe is best for the future of amateur radio."

Members are urged to contact their ARRL directors to comment on this proposal.

Forwarded from a Cornell (University) ARC Newsgroup bulletin by Shaun Gartenberg KB2JNW, via WA2YYX.

We'd Choose a Somewhat *Stronger* Word

On the night of 14 October 1996, the aircraft carrier *USS Theodore Roosevelt* and the cruiser *USS Leyte Gulf* were engaged in predeployment drills and tests off the Atlantic Coast. The *Roosevelt* was testing its Challenge Athena communications system, which was getting interference from the ship's radar system. At the same time, the *Roosevelt* was also testing its propulsion systems and conducting electric power shifts—which caused communications gear to cease operations at times. Part of the propulsion system tests included putting the engines astern for long periods of time.

The *Leyte Gulf* was trailing the *Roosevelt* at a range of about 4,000 yards, and had not been informed of the tests being conducted on the *Roosevelt*. Because the communications systems on the *Roosevelt* were not able to be used, the two ships were using flashing light to exchange messages—a method used in yesterday's navy, but apparently a lost art today. It took 25 minutes for one message to be received and passed on to the bridge. Flashing-light messages are sent using Morse code, and the text of the message that was received was garbled.

At 2:44 A.M., the *Roosevelt* went to "Emergency Back Full" on its engines and was going astern at 17 knots. At 2:49 a signalman aboard the *Roosevelt* started to send a message that said, "My engines are astern." The *Leyte Gulf* had not been told of this maneuver and the officer of the deck was confused by the movement. After recognizing the danger that was approaching, the *Leyte Gulf* also went to "Emergency Back Full" on its engines, but it was too late to avoid a collision. The *Roosevelt* and *Leyte Gulf* collided at 2:52 A.M. The result? *Over $10,000,000 in damage* to the two ships. Fortunately, there were no deaths or serious injuries involved.

The Board of Inquiry results stated that 25 minutes to deliver one message by flashing light using Morse code was "unsatisfactory."

TNX Jack R. Main W4YCZ. This appeared in the May 1998 issue of the *W8KEA Midland ARC* newsletter, Judy Engel KB8WEE, editor, but we got it from the *ARNS Bulletin*, June 1998 issue.

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NEVER SAY DIE

continued from page 39

no longer taught, and there often is no documentation. This means searching through hundreds of millions of lines of code, a task that many companies have been putting off because of the expense.

But how can a large business, that depends on its mainframe computer every day, shut it down for the needed repairs? Worse, once the repairs to the software have been made, then comes the testing and debugging, a process which normally takes longer than the original writing of the code.

According to North, not one of our power companies is yet Y2K compliant. So how can programmers do the needed software repairs without electricity? Uninterruptible power units use batteries, which are okay for a few minutes, but not for days. Some systems may have gasoline or diesel generators, which is fine as long as they can keep getting fuel.

If you start reading the Web postings on the subject, you'll find that knowledgeable analysts and programmers are moving from the cities to places where they can live self-sufficiently. They're buying small farms, stocking up on food, making sure water is available, and putting aside a bunch of small bills for when the ATMs stop working. Having lived in New York City for over 30 years, I can imagine what it could be like with no electricity, no water, no sewer, no food, and every highway out of the city blocked with cars that have run out of gas. That's when bicycles could be sold for thousands of dollars.

Y2K Continued

Endless experts in the software field are telling us that much of the world is going to suddenly stop when the computers, which are running almost everything these days, suddenly stop. Our country's and the world's banking systems are not "compliant." Our power companies ditto. Without power or money our food supply system will stop. Without fuel our farms will stop producing food. Without trucks or trains the entire country will grind to a halt.

Knowledgeable programmers are busy packing up and leaving the cities and moving to small farms.

Having had several software companies, I know from personal experience how long it takes to debug software. My rule of thumb, learned the hard way, was to multiply programmer estimates by seven. A recent survey showed that on the average, successful major software projects run 25.8 months behind schedule — with 65% of them having to be canceled, mainly due to unresolved bugs. The industry estimate for checking new software runs to about 125% of the time needed to develop it initially.

So here we are with a date bug that could crash most of our older computer mainframe systems. Many of the programs were written in Fortran, Cobol, Assembler, and other mostly long-forgotten languages. The fix is to go through every line of code looking for any date references and calculations. We're talking about millions of lines of code for most larger companies.

How much do you pay a programmer to learn how to cope with an old language, work like hell for the next year doing mind-numbing line-by-line work, and then get laid off when the job is done?

When the lights, water, and food are turned off, what will the people in our cities do? And maybe turned off for months to years? With most businesses and factories closed down, including the banks, there's no income, nor any real prospect of it. Without banks, what value will money have? The banks don't have any cash anyway. Their business is lending out your money for mortgages, but all the data on who owes what will be tied up in their shut-down computers.

If everything suddenly stops on January 1, 2000, will you have enough food and water to keep you and your family alive? And if someone less provident comes with a gun, you won't be able to dial *911*. Plus, the police won't have any gas for their cars anyway.

I'm hearing from more and more people who have recently left the cities and moved to New Mexico, Arizona, Idaho, southern Colorado, Montana, New Hampshire and Vermont.

Now, is Wayne exaggerating? Before you dismiss the problem, do some of the homework I have. Talk with some people who are experts in software. With today's network of computers, all it takes is one crash somewhere and the dominoes will fall. Remember when a glitch in Canada brought down the whole eastern power system? For hours?

I can remember when insurance companies had whole floors of people at their desks with calculators. Now it's all done by a few people and a mainframe computer. Their programs were developed by now long-gone software houses.

Hmm, maybe I should start raising chickens again here on our farm. Just in case.

Bargain!

A couple years or so ago I reviewed the Graham Hancock book, *Fingerprints of the Gods*, and added it to my list of books you're crazy if you don't read. Hancock has done a magnificent job of visiting the sites of ancient civilizations and writing about them. He ties together the folk tales from the people in these areas into a story of an ancient cataclysm which wiped out most of the Earth's civilizations, including the possible burying of Atlantis beneath the Antarctic ice.

His well-researched material on the pyramids and the Sphinx will give you endless conversational fodder. Well, it will *seem* endless to your friends or to anyone you can con into listening to you on the air.

The 578-page hardcover book was a bargain at $27.50, but here's the big news — I found the $17 paperback edition remaindered at Building 19 for $5. Wow! Check your local stores that carry remainders and grab this one, if you see it. It's a great read — a historical detective story.

Quiz

A high school buddy I keep in touch with, Chuck Opitz WA3YQV, sent me the following quiz. Let's see how you do. (1) How many birthdays does the average man have? (2) Some months have 31 days; how many have 28? (3) How many outs are there in an inning? (4) Divide 30 by 1/2 and add 10. What's the answer? (5) If there are three apples and you take away two, how many do you have? (6) A doctor gives you three pills, telling you to take one every half hour. How many minutes would the pills last? (7) How many animals of each sex did Moses take on the ark? Give up? (1) One. (2) All. (3) Six. (4) Seventy. (5) Two. (6) Sixty minutes. (7) Moses? Perhaps there's much to be said for letting go of old friends.

Weather

The black fly season was mercifully short this year, but I've never seen the mosquitoes in such swarms. It's more like when I was working in Florida and I'd park my car as close to the door to the radio station as I could and sprint for it. Maybe 10 seconds later I'd be inside, slapping at the mosquitoes that had landed on me. That's when I was working as an engineer-announcer at WSPB in Sarasota.

We've also been having the worst thunderstorms in my memory, and my memory goes back a lo-o-o-ng way. It's been raining almost every day, so mowing and getting in the first growth of hay from our pastures wasn't possible until the first of August! The grass was almost hip high. But, on the other hand, the wildflower display was spectacular. My daughter Sage and I enjoyed the display the other day. Golly, I wish you could get up here to New Hampshire for a visit!

All this is a reflection of the changes our world is going through. The *El Niño* rains. The tornado in Antrim, just over a mile away. The fires in Florida. The increase in earthquakes all around the world, and the volcanoes. An astronomer the other day said that he's never seen the Sun active the way it has been recently.

It's amazing how things are connected. The hundreds of new volcanoes under the Pacific Ocean have heated it up, giving us the *El Niño* rains, and they, in turn, have produced the bumper crop of mosquitoes. Hmm, now what started all those volcanoes acting up? Was it underground nuclear tests or the Sun?

Our 70 cm Band Challenged

The Land Mobile Communications Council has petitioned the FCC to take away two-thirds of our 450 MHz band. Maybe they got the idea from the ease with which commercial interests were able to get a big lump of our 220 MHz band. The present use of the band on a primary basis by radar may be enough to hold it for us. We'll see whether the military and other radar-using agencies have more clout than the land mobile lobbyists. We're kind of

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LETTERS

continued from page 6

free-running clock, with a few seconds error per day that is reset at midnight with a one-second error. Traditional electric clocks using synchronous motors have about an order of magnitude smaller error.

The receiver tuned to WWVB has an insufficiently small antenna, so that in fringe reception areas, such as the West Coast, it must be placed in a window facing Colorado to receive the signal with enough SNR to function.

RTTY LOOP

continued from page 55

listing frequencies of interest to those who like to scan for various utility and commercial services. This information may be had at [http://www.frankfurt.netsurf.de/~mike/hf.htm].

Or the Scandinavian Amateur Radio Teleprinter Group. Presented in, well, Scandinavian (Swedish? Danish?), this is a source of help to the radio amateur that also includes listings of hams willing to lend a hand. I can't translate it, but at least some of it is recognizable as jargon. You be the judge at [http://www.plea.se/sartg/].

An Italian site which catalogs an assortment of ham radio resources, including those specific to radioteletype, packet, and other exotic modes, runs under the name ARI - Altri WWW. This one can be figured out, even if you don't know Italian! See if you can read it at [http://www.telemar.it/mol05/ari/html/altriwww.htm].

An ambitious amateur project, complete with the institution of ham radio banner advertising, is K1DWU Dot Net. Amateur radio news, links, and other information is presented in a clean, functional site. You should find something interesting at [http://www.k1dwu.net/].

Ian Kluft KO6YQ tells the tale of how he started collecting links, and ended up with an encyclopedic listing of amateur radio on the Internet. With a listing in table-of-contents format, hot links to the sections, and full URLs spelled out, this listing is easy to search, and easier to use. I highly recommend it if you are looking for that special information about some aspect of amateur radio. See if you agree at [http://www.kluft.com/~ikluft/ham/list.html].

Winding up our tour, Steve WA7YAZ has a visually appealing page that supports a great deal of ham radio information. From lists of ham radio magazines on line to hot links into the amateur radio newsgroups, this is a very interesting site. Make sure your browser is set up for newsgroups, though, or you will crash if you select one. See what I mean at [http://www.utw.com/~yaz/wa7yaz.htm].

By the way, a word about some of these URLs. Many of the site addresses on the World Wide Web include the *tilde* character (~). It is very important to notice when that character appears, use it correctly, and don't substitute a hyphen (-) for it. Many of the E-mails I receive stating that this or that published Web address was wrong involve a misplaced *tilde*. A word to the wise ...

Ribbons

Now, a few months ago, we were looking into the topic of ribbons. A variety of techniques, from stamp pad ink to WD-40, were suggested to re-ink or prolong the life of teleprinter ribbons. I received a letter from Jim KcKelvy W9DJN of Medina, Tennessee, who addresses the point with authority:

"Trying to ink ribbons with such chemicals as WD-40, stamp pad ink, and glycerine are, at best, a poor substitute for the *correct* ink."

Computer Friends, of Portland, Oregon, is one source he located. He further advises:

"They have the proper lubricated ink in various quantities. A two-ounce bottle will ink many ribbons.

"I have been inking ribbons for several years. In fact, this document [the letter he sent me with nice, dark, type] is being printed on a dot matrix printer with an Epson ribbon that has been inked several times.

"Application of the ink is another story. The above source sells a ribbon inker. This device consists of a small motor that pulls the ribbon past an ink metering well. In my case, it takes about 12 minutes to ink the ribbon. The motor shaft accepts various adapters to accommodate different ribbons.

"I understand there were commercial inking devices that one could attach to the teleprinter. I never used one, but see no reason the above mentioned ink would not work out.

"At some hamfests I have seen vendors selling small bottles of ink for ink jet printers. DO NOT use this ink. It does not have the proper viscosity.

"I agree with your assessment of cotton *vs.* synthetic ribbons and the comment about cellophane. But, if the ribbon material is still good, just ink those old surplus guys."

Computer Friends has been in business since 1982. In their words, the first product made was the MacInker, a universal ribbon re-inker, of which they have sold over 350,000 units to date. Ironically, the product name had nothing to do with the Macintosh. With a dash of optimism they had dreamed of being able to produce a banner (one day) reading "Over 100,000 sold," after the fashion of a well-known fast food franchise. They have expanded their lines, though, and now sell much more than that early product. You can contact them at:

Computer Friends
13865 NW Cornell Road
Portland OR 97229
Ordering: 1 (800) 547-3303
Tech Support and Questions:
(503) 626-2292
[http://www.cfriends.com]

Just be sure to tell them that you read about them right here, in *73 Magazine*'s "RTTY Loop," OK?

Activity on the Web site slowed down over the summer, which I had expected, but is picking up now that fall has arrived. We plan to do some housecleaning and upgrading over the fall, with new items being added and older ones taken down. Check the site at [http://www2.ari.net/ajr/rtty/] and see if anything up there takes your fancy! Let me know what you like, what you dislike, and what you'd like to see. I'll see if I can accommodate you. Check back here next month, for more from "RTTY Loop," the original source for RTTY information.

---

like remoras, just going along for the ride and picking up any leftovers while the sharks eat.

Peoria

If you're within hard driving distance of Peoria and aren't there on Saturday, September 19, for my talks, I'm going to find it very difficult to forgive you. And never mind that blessed to forgive baloney. I'm going to hold a grudge, and if I don't get over it in this life, I'll nurse it for a lon-n-ng time in whatever comes next. Do you really need that kind of bad karma? Heck, life is tough enough as it is.

None of that shifty-eyed weasling — just be there. And bring some money so you can buy the books I've written that you should have sent for, but haven't. Bring lots of money.

One more thing: If you're enjoying my writing, give me a big hug. Okay? You don't want me getting discouraged, retiring and taking up golf, do you? Thin chance.

Number 63 on your Feedback card

PROPAGATION

Jim Gray W1XU/7
210 E Chateau
Payson AZ 85541
[jimpeg@netzone.com]

September 1998						
SUN	MON	TUE	WED	THU	FRI	SAT
		1 F	2 F-G	3 G	4 G	5 G-F
6 F	7 F	8 F	9 F-G	10 G	11 G	12 G-F
13 F-P	14 P	15 P-F	16 F-P	17 P	18 P-F	19 F
20 F	21 F	22 F	23 F	24 F	25 F-G	26 G
27 G	28 G	29 G	30 G-F			

As this forecast is being prepared (early June) the solar flux values are staying consistently in the range between 90 and 120, and the bands reflect this by producing good DX. There is every reason to suspect that the upward trend has now begun, and by September (this forecast) you can expect even better DX opportunities with stronger signals on good days.

As the calendar shows, the very best days (G) are likely to be the 2nd–5th, 10th–12th, and 26th–30th. The poor (P) days are likely to take place between the 13th and 18th and I expect the 16th, 17th, and 18th, specifically, to present other geophysical upsets as well, possibly in the form of violent weather.

10–12 meters

Fairly good transequatorial DX should occur during local afternoons. Also, some F2-layer openings on east-west paths to Africa and the South Pacific may be possible in the morning. Short skip out to 2000 miles or so ought to be available in the afternoon.

15–17 meters

Reasonably good DX to all areas of the world, especially to Africa, South America and South Pacific during daylight hours and peaking in the afternoon. Short skip openings to distances greater than 1000 miles should be common.

20 meters

Expect openings to all areas of the world from morning to evening (see band/time/country chart), peaking locally an hour or so after sunrise and again during the afternoon. Short skip beyond 750 miles should be good during the day.

30–40 meters

Fairly good worldwide DX openings may be expected from early evening through sunrise, short skip from 100 to 1000 miles during the day, and beyond during darkness hours. As always, QRN can be a problem, but should be abating this month.

80–160 meters

On 80 meters, you may find fairly good DX openings to the southern hemisphere during hours of darkness and sunrise, short skip to about 350 miles during the day, and out to between 500 and 2000 miles at night. On 160 meters, look for DX during the hours of darkness and just before dawn. Short skip should be available from 1500 to 2300 miles at night.

When reading the band/time/country chart, remember that a higher or lower band at a particular time, to a specific country, can produce good results. W1XU/7.

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20					20	20				15
ARGENTINA	20	20	40	40						10	10	15
AUSTRALIA	15		20			40	20	20				15
CANAL ZONE	15	20	40	40	40		20	20	20	10	10	15
ENGLAND	40	40	40	40			20	15	10	10	20	20
HAWAII	15	20	20	40	40	40	20	20			10	10/15
INDIA							20	20				
JAPAN	15	20					20	20				15
MEXICO	15	20	40	40	40		20	20	20	10	10	15
PHILIPPINES							20	20				
PUERTO RICO	15	20	40	40	40		20	20	20	10	10	15
RUSSIA (C.I.S.)	40	40						15	15	20		
SOUTH AFRICA	20								15	15	10	20
WEST COAST	40	80						20	20	20	15	40
CENTRAL UNITED STATES TO:												
ALASKA	15											15
ARGENTINA	15	20	20	40	40						10	15
AUSTRALIA	15	20	20	20		40	80					15
CANAL ZONE	15	20	20	40	40			15	15	10	10	15
ENGLAND		40/80	40/80			15/20	15	15	20	20	20	
HAWAII	15	20	20	40	40	40	80	20			10	15
INDIA								20				
JAPAN	15											15
MEXICO	15	20	20	40	40			15	15	10	10	15
PHILIPPINES	15	20						20				
PUERTO RICO	15	20	20	40	40			15	15	10	10	15
RUSSIA (C.I.S.)								20	15	20		
SOUTH AFRICA	20									15	15	20
WESTERN UNITED STATES TO:												
ALASKA	10/15	15	15	20	20	20	40	40				15
ARGENTINA	10/15	20	20	40							15	10/15
AUSTRALIA	10	15	15	20	20	40	40	40	20	20	15/20	15
CANAL ZONE	20	20	40/20	40/20	40			20	15	15	10	10
ENGLAND										15/20	15-20	
HAWAII	10	15	20/15	40	40	40	40	40		20	20	20
INDIA	15/20	15/20							20			
JAPAN	10/15	15	15	20	20	20	40	40				15
MEXICO	20	20	40/20	40/20	40			20	15	15	10	10
PHILIPPINES	15/20	15/20		20		40	40		20	20		15
PUERTO RICO	20	20	40/20	40/20	40			20	15	15	10	10
RUSSIA (C.I.S.)									20			
SOUTH AFRICA	20	20								15	15	20/15
EAST COAST	40	80						20	20	20	15	40

Number 63 on your Feedback card

HAM HELP

We are happy to provide Ham Help free on a space-available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double-spaced, on a full 8-1/2 x 11-inch sheet of paper. Use upper- and lowercase letters where appropriate. Also, print numbers carefully. Specifically mention that your message is for the Ham Help column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

Massachusetts mystery

I am looking for information on a Grundig radio built for the Americas. It is shortwave, AM, FM and stereo. I would like to know who fixes them or knows of a source for leftover new parts. Is there a Grundig club? The model number is RF 2600/Stereo, FM 13 circuits, solid state AM 7 circuits. The address on the radio is Grundig Werke GMBH Furth/Bayern, W. Germany. *Kris Hermanson, P.O. Box 273, Westminster MA 01473.*

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Barter 'n' Buy

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it, rather than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The *73* Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial!) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the December 1998 classified ad section is October 10, 1998.

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